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CONTENTS:

	PAGE
Accidents from Shock, and their Treatment	733
Symbols and Abbreviations	734
The Utilisation of Wind Power	736
Experimental Investigations into the Origin of Frictional Electricity (*illustrated*)	736
The Royal Society and its Critics	738
Small Dynamos: Their Construction	739
Correspondence:—	
Electricity in Mines	740
Speed Indicators	740
Re Folkestone Electric Lighting	741
Accumulators for Tramcar Traction	741
The Design of Small Dynamos	741
Obtaining Continuous from Alternating Currents	741
Legal:—Shelfer *v.* The City of London Electric Lighting Company	742
Muirhead *v.* Commercial Cable Company	742
Grist and Another *v.* Fowler-Waring Cables Company ...	743
The Electrical Power Storage Company *v.* The Chloride Electrical Storage Syndicate	743
Business Notices, &c.	743
Contracts Open and Closed	746
Notes	746
City Notes	750
Traffic Receipts	750
Share List of Electrical Companies	751
The Early Morning Test in Telephone Offices (*illustrated*) ...	752
Board of Trade Inquiry Regarding Transformer Chambers ...	753
Proceedings of Societies:—	
The Institution of Electrical Engineers	754
New Patents	756
Abstracts of Published Specifications	756

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ACCIDENTS FROM SHOCK, AND THEIR TREATMENT.

IT is remarkable that so eminently practical a people as the Americans should continue to tolerate the sensational methods of its Press. Give the western editor but the most slender of opportunities, and he will do his best to set the whole world agog. Recently a Mr. Cutler, of Pittsfield, Mass., had the misfortune to receive a shock of very high voltage, but also had the good fortune to recover from the same, owing, it is said, to prompt and suitable measures being taken, and now all the daily newspapers of any consequence in the United States are arguing the question whether electrocution kills. As if such a question could be settled by mere academic reasoning! The technical Press, too, have joined in the discussion, and have even copied the methods of the lay Press, using "catch-penny" titles in order to assist in "stirring up the public mind concerning the inefficiency of the penalty which the State accords to those who have been found guilty of taking human life."

We are not surprised to find that the mere newspaper man should consider himself qualified to settle a scientific problem by means of a brilliant article evolved from his own inner consciousness; but that the technical Press should also join issue with the weapons of mere argument, based upon no adequate experimental data, is, from our point of view, little short of astounding. It was this attitude towards natural phenomena which hampered the progress of science for centuries. We rejoice to find that some of the American electrical papers have not quite lost their balance; and though much that we find in their columns concerning this subject is, in our opinion, unworthy of them, it is something to observe that they call for a scientific investigation of the matter.

But how is such an investigation to be conducted? Human subjects are not likely to be obtainable, whatever the premium. Dr. Gibbons, of Syracuse, N.Y., is stated to have offered his own *corpus vile* for experiment, provided his own peculiar method of resuscitation be practised upon him by a competent committee of medical men; but, as even he would admit, scientists would be unable to draw, or indeed, to attempt to draw a general conclusion from an isolated instance. Could he induce a few dozens of those journalists who have been battering the subject in their own approved way to join him, then, if they were "killed" and brought to life again, they would at least have earned a right to live and to "interview" each other on their experiences for the rest of their natural days; whilst from such a number of experiments it might be possible for scientists to venture upon some conclusion. This method of investigation, however, is not likely to be received with much enthusiasm. On the other hand, it is seriously urged that murderers who have incurred the death penalty are the proper subjects for

investigation. Such experiments, argues one of our American electrical contemporaries, "would be of great value to humanity, regardless of the fate of the murderer who is brought back to life after suffering the mental torments of the damned." By adopting this course, it says "the science of electrics would not be disgraced, and the feelings of the murderer should not be taken into consideration." Another of our contemporaries calls for a State Commission to undertake these experiments upon murderers.

Now, as we have remarked before, when dealing with the subject of experiments upon persons condemned to suffer electrocution, we are of opinion that such experiments would not only be unwarrantable and repugnant to the spirit of civilisation, but would probably prove nothing. The resuscitation of an electrocuted criminal would only show that this particular electrocution had not been carried out properly. As to the precise legal status of a re-animated murderer who had paid the death penalty, we should find ourselves confronted with a dilemma which it would be difficult to face; but that is not of so much consequence.

There is certainly room for some kind of investigation, whether it be upon men who have accidentally sustained severe electrical shocks, or upon animals. For although Mons. D'Arsonval claims to be able to resuscitate persons who have been killed by electricity, and is ready with instances in which efforts have been successful, Prof. Edwin J. Houston and Mr. Kennelley have conducted experiments which tend to disprove these claims. Mons. D'Arsonval again states that on making an autopsy of a person who had been thus killed accidentally, he "found nothing after the most careful examination in the lungs, head, or heart, to explain the cause of death." But, on the other hand, a doctor, who was a State witness at the last electrocution in Sing Sing Prison, made this report:—"All the arteries of the brain were apparently ruptured, the heart entirely empty, and the lungs nearly or quite so. Under such circumstances life must be absolutely non-existent a moment after the first shock."

To our unprofessional minds it is inconceivable that life could, by any means whatever, be restored to a person, the arteries of whose brain were ruptured. The case of Mr. Cutler, who sustained a momentary shock, and was successfully revived by the D'Arsonval treatment within a few minutes, is in no way analogous to the case of a criminal whose body is subjected for ten minutes, or more, to the current. If, as seems likely to be the case, a momentary shock stops respiration, then it is perfectly reasonable to assume that artificial respiration, intelligently persisted in, may succeed: indeed, it is this belief which has led us to issue certain suggestions for the resuscitation of persons who have received an electric shock. It is not reasonable, however, to suppose that this treatment will be successful where extensive lesions in the nervous, circulatory, and respiratory systems have been set up by prolonged exposure to the current.

Our contemporaries in America, for the most part, appear to have been losing sight of the only issue from this subject which is really worthy of consideration. That the death sentence by electricity is properly and efficiently carried out there is not the slightest doubt. What is important is the fact that a man who received for a moment a current at a pressure of 4,600 volts into his body, was in a few minutes revived by a simple manipulation designed to promote artificial respiration. Whilst accidents of this kind will be rare in the future (as indeed they really are now), it is certain that they *will* take place; consequently, if such cases can be successfully treated by any persons who happen to be on the spot, provided that they possess a certain knowledge within the capacity of any ordinary man, we ought to be at pains to possess ourselves of, and to disseminate such knowledge. Thousands have had their lives saved from the effects of apparent drowning, owing to the instructions which the Royal Humane Society and other organisations have posted up at spots where such accidents are likely to occur. Suspended respiration is the chief symptom exhibited by a person who is apparently drowned; it is also, it seems, the chief symptom shown by a person who has accidentally received for a moment an intense electric shock. It is not unreasonable to suppose, therefore, that the remedial measures found to be successful in the one case may also be successful in the other. On this hypothesis, apparently, Mons. D'Arsonval bases his treatment. Artificial respiration, by preventing asphyxia, will reinstate natural respiration.

If a person were brought to Mons. D'Arsonval who had received a momentary, but very great electric shock, we presume he would proceed as follows: The person would be placed flat upon his back; the tongue would be drawn out very vigorously as far as possible by twisting a handkerchief round it, and at the same time the arms would be raised over the head; then the chest would be compressed slowly and regularly. This treatment would take place at the rate of about 16 times per minute. If only one helper is available the movement of the arms alone might be successful. As in cases of drowning, it is necessary to persevere; it may take five minutes to restore animation, or it may take five hours. The operator must never give up hope. Besides D'Arsonval, Drs. Goelet, Hedley, and Lewis Jones have specially considered this important subject, and upon the results of all their experiences we have based and issued some simple directions for restoring animation, capable of being understood even by an ordinarily intelligent labourer.

The College of France recommends in cases of suspended respiration the application of the faradic current on both sides of the larynx under superficial incisions in the skin; but this is obviously a course which no ordinary bystander, nor even a general medical practitioner, could be ready to adopt. Amongst other remedial measures, there is the use of nitro-glycerine in 1 per cent. solution, in two-drop doses, dropped at intervals upon the tongue; this is the most powerful heart stimulant known to the medical profession. Failing this, stimulants such as alcohol, ammonia, &c., are recommended for the purpose of arousing the cerebro-spinal system to action. But of all these remedies, the simple treatment proposed by Mons. D'Arsonval will be most capable of being applied by the average human; and in view of the one authentic case in America, where a man did receive this treatment and did revive, it is at least incumbent upon us to make it as widely known as possible, even though it may be based upon such slender experimental evidence.

SYMBOLS AND ABBREVIATIONS.

Our esteemed American contemporary, *The Electrical World*, in its issue of November 24th, again returns to the attack, by way of rejoinder to our leaderette of November 2nd. We really cannot compliment our contemporary on this reply, as regards either accuracy, tone, or pith. For example, it says: "Prof.

Jamieson was at Chicago, we believe, and must have been aware that the system of Prof. (*sic*) Hospitalier was to be brought before the chamber of delegates. He should then have entered his objections, which he certainly could have done through one of the delegates." . . . . "Finally, the system of Prof. Jamieson was embodied in a paper read before the Congress. . . . ."

The facts of the whole case are these. Prof. Jamieson was at Chicago, and was aware that M. Hospitalier's system was to be brought before the chamber of delegates. Further, he offered to read a paper on the subject before the Congress, and his offer was accepted. Before leaving home, accordingly, he had a large number of slips printed, in illustration of the views he meant to set forth. On his arrival at Chicago, he was informed by those in authority that, seeing that a committee had been formed to consider the whole subject, it would be neither just nor proper to discuss it at any of the ordinary meetings. In this view he acquiesced, the more willingly because he was given distinctly to understand by delegates occupying official positions, that the committee, before submitting their decisions to the delegates, would give to all members interested in the subject, ample opportunity of expressing their views. Shortly before the committee met, however, it transpired that they had finally decided not to hear the views of anyone on the subject, and to hold their meeting *in camera*. Prof. Jamieson immediately sent to the committee's secretary the printed proofs which he had had prepared, with the request that he would distribute them amongst the members of the committee. This, the secretary unfortunately omitted to do, for, after the meetings, the whole of these slips were found intact at the bottom of his hand-bag! The upshot of all this secrecy was, that nothing about the committee's proceedings was divulged until after they had presented their report, and even then, no reliable information was imparted to individual members. True, a short report of the meeting, accompanied by a table of symbols, &c., appeared in *The Electrical World* of September 23rd, 1893 (*i.e.*, fully three weeks after the termination of the Congress), but as Prof. Jamieson had then no means of verifying its authenticity and accuracy, he took what he was undoubtedly justified in doing, the very earliest opportunity of criticising the complete and authentic recommendations of the committee. Our contemporary is not accurate when it alleges that "the system had been before the world for some years; it had been formally brought in 1891 before the Frankfort Congress, and was by it referred to a committee for report to the next Congress, and it was published by the committee on the Provisional Programme for the Chicago Congress *in order to invite discussion. It is rather unreasonable, in the light of this, to imply that there was not ample opportunity to publicly criticise the measure.*" (The italics in the above quotation are our own.) We quite admit that a system was brought before the Frankfort Congress by M. Hospitalier in a paper which he read there; but that it was "before the world," as a complete proposal, we do not admit. Further, it was referred to a committee, not for report to the next Congress, but "to examine this system . . . in a general way, and to submit it to practical tests; to publish shortly in the special technical journals the results of their examination, with a view to a common understanding, and to leave it to the next Congress to establish definitely this system of notation." How far this committee has fulfilled its functions we leave it to the public to judge. Had they even gone so far as to publish an account of the proposed scheme in the technical journals, it would have been better than nothing, and would have afforded ground for discussion. With regard to the statement that "it" was placed on the Provisional Programme in order to invite discussion, we should like to offer two remarks. The general subject of "The consideration of an International System of Notation, &c." undoubtedly was there, but certainly not any particular system whatsoever; discussion may have been invited, but instead of being accepted it was burked. The foregoing remarks will serve to show how much opportunity has hitherto been given for a fair expression of opinion, or what pains have been taken by the committee to ascertain what other people thought. Our criticism of the constitution of the committee—as an International one—was certainly called for, and is amply justified by the list of names as given by *The Electrical World*, viz., Ferraris, Ayrton, Carhart, Hospitalier, Palaz, A. Siemens, and Budde. The only real Britisher on the committee is Prof. Ayrton, and he, unfortunately, was not able to be present at a single meeting! Moreover, Profs. Carhart and Hospitalier are the only two men in the above list who have made anything like a special study of this matter, and who could be designated "experts" in electrical notation.

Apart from all these considerations, however, we admit freely and fully that the system is about as good and as perfect as such a "one man" system can be. It is conceived upon intelligible, common sense principles, and betokens on the part of its author much care, and a painstaking appreciation of the subject. Much credit is due to M. Hospitalier for his earnest labours in constructing it, and to our contemporary for really making it known to the electrical world. But whilst admitting all this, we do not thereby relinquish our right to criticise the system as a whole, or in part, and we are quite at a loss to imagine why it is that our contemporary accepts with such a poor grace the remarks that have already been made. We have said this much by way of justifying our own and our correspondent's position in this matter, and we consider that we have succeeded in showing that the present is undoubtedly the best, because it is the earliest possible time for criticising the whole system.

Our contemporary remarks that the criticism of Prof. Jamieson "repudiates almost every essential point of the International Congress system." We have again looked carefully over that criticism, and we cannot make out how any fair-minded man can see in it a repudiation of any essential point whatever, unless it may be the matter of so-called French Script *versus* Grotesque (so-called "block") letters. How far that matter is considered essential, even by M. Hospitalier himself, may be gathered from his article on the subject in *The Electrical World* of August 26th, 1893, in which he avows his preference for the former (French Script) "on account of the time required in writing these latter characters with the pen or on the blackboard!" We have been making inquiries at some of our leading printers who have had large experience in scientific and mathematical work, and not one of them ever heard of *French script*. Moreover, we have turned up the illustrated lists of various type founders, and can not find these characters. There are many forms of script letters, but none termed *French script*, the nearest approach to it being here known as *Ronde type*. No two founders, however, make them exactly alike! All printers, however, have the plain, bold, *grotesque* letters, and are well acquainted with them. With all deference to Prof. Hospitalier's opinion, we consider still that the well-known, easily written and distinguished *grotesque* (or *block*) letters ought to be appropriated to the oftener used and more important magnetic quantities; and that the various quantities pertaining to light (which are comparatively seldom used here) will be much more appropriately represented by the lighter, more fanciful *French script*. The remainder of Prof. Jamieson's criticisms was directed to what he conceived to be faults of detail, rather than errors in principle. It is all very good to have a thing constructed on right and proper principles, but if it is to be a workable scheme, it must be carefully elaborated in its details, so that nothing which is likely to cause confusion or misunderstanding, or needless worry, may have a place there. We consider that we have done no more than our duty if we have succeeded in directing public attention to the manner in which this most important matter has been carried through.

THE UTILISATION OF WIND POWER.

By RANKIN KENNEDY.

The active forces of nature are not made much use of. We prefer to use the stored energy in fuels, coals, oil, or gas, for the reason that we can always call upon them when wanted.

The energies in the waterfall, the wind, and the sunshine, are active powers, but not controllable to any extent, and to make any use of them we must first find a convenient and effective method of storage, so that we may lay up a store in times of plenty, and draw upon it in times of scarcity. The water we may store in a pond or reservoir; the wind also may be stored in a reservoir; and that is the point this article touches upon.

Wind power has been used in electric lighting for driving dynamos in times of plenty, and storing the energy of electricity in storage batteries, to be drawn upon in time of need. But that method is very limited, and has several serious drawbacks.

First, the windmill is a machine which runs at very variable speeds, while the dynamo requires for its best performance a constant speed. The consequence of this is that only winds blowing along at a certain speed can be utilised.

The storage battery also demands a fairly constant pressure to charge it; if the pressure falls below a certain amount, it ceases charging altogether; if the pressure rises to a high figure the battery boils, and the charge is by no means proportional to the energy delivered to it.

For these reasons the storage battery fails to meet the requirements as a direct store for the energy of the winds.

We want a store which will at all times take in the energy taken from the wind, whether it is great or small, not refusing the small morsels nor wasting the abundance.

Again, a storage battery cannot charge and discharge at the same time; there is no non-return valve for the electric energy; this is also a great drawback in using it for wind power.

The only solution of the difficulty is to store the wind itself; that is, to store the energy in compressed air.

This is no new proposal; it is an ancient one, resurrected and inspired by up-to-date knowledge and appliances, and if looked at carefully, the scheme is not only plausible, but practicable, and if intelligently carried into practice would furnish a plant for electric lighting in many places, on a small scale, which would effectually apply wind power as the prime mover.

The windmill is preferably of the horizontal type, like Rollason's, ready to go at all times, and with any direction of wind; this mill drives air pumps, compressing air into reservoirs (steel boiler shells), up to a pressure of 10 atmospheres or so.

In this system of storage, speed is of no consequence; the pumps will deliver their full capacity per stroke, whether the mill makes one or a hundred revolutions per minute, and the store may be drawn upon while storage is going on.

The compressed air may be led by a pipe with little loss over long distances, and, by means of an ordinary engine and dynamo, the energy can be efficiently converted into electric energy when and where it may be wanted.

And, further, we may now bring in our electric storage battery effectively, for with a storage battery added to this windmill compressed air system we can make a more effective use of both, for in many cases the air storage would be full up when yet plenty of wind power was going. In such a case the storage batteries could be stored up full, thus utilising the power of the wind still further, and providing a double storage against the calm which follows the storm.

The mill and pumps can on this system run 24 hours a day, so that in cases where the light is wanted for only a fraction of this time per day, the stored air would, as a rule, be sufficient for the purpose. The double storage would provide against failure in most cases.

The plant, complete, would consist of a horizontal wind motor, compression air pumps, and reservoirs; these would be placed in an exposed place, the reservoirs may be underground, and the air pumps housed in the pedestal of the mill. This part of the plant would entail a considerable outlay in first cost, but very little for maintenance.

At the house to be lighted a small engine and dynamo would be required, and, if necessary, a storage battery, the engine being connected to the reservoirs by a pipe led underground, like a water pipe.

Although there is nothing new in storing compressed air for power purposes by means of a windmill and pumps, no proposal to apply the combination with a dynamo and storage battery for electric lighting seems hitherto to have been published, and yet it seems a very feasible method of making use of a power available in almost any place, especially in places where steam and water are not available.

The plant costs a good deal, owing to the high price of steel shells for reservoirs, and the high price of storage batteries; but the working expenses would be low.

There is a good deal of scope for engineering skill in designing and erecting such a plant as this; in fact, its success or failure depends altogether upon the selection of details. A great deal depends on the design of the wind motor, the air pumps, and the engine. The dynamo and storage battery require no special considerations, it is, therefore, practically a mechanical engineering job.

In this article we cannot enter into particular details, many of which are of peculiar interest. Meanwhile, it is desired only to direct attention to a promising method of utilising wind power for electric lighting in small isolated plants.

In compressed air we have a storage which exactly meets the requirements of an intermittent variable power. The only drawback to the system is the great first cost, but that is not so great as to render the system prohibitive in every case.

In some cases where an elevated reservoir for water can be readily formed, the windmill may be employed to pump water continually up into this reservoir, and a turbine and dynamo used to reconvert the energy into electricity. But such cases are exceedingly rare where the elevation and the water can be had, and frost has always to be counted upon; and the water may be scarce when the wind is plentiful, or *vice versa*. Compressed air can be used anywhere, and frost has no effect on it.

EXPERIMENTAL INVESTIGATIONS INTO THE ORIGIN OF FRICTIONAL ELECTRICITY.

By C. CHRISTIANSEN. *

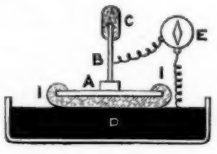
In seeking for the origin of frictional electricity, it is necessary to consider in the first place what sources of electricity are available. Besides friction we have pressure and impact, but they lie so close to friction that they are of no use to us. The remaining sources of electricity to be more especially examined are, contact electricity, thermo-electricity, and induction. There is no analogy between induction and friction as sources of electricity: the origin of thermo-electricity is still very doubtful; but there is a great analogy between frictional and contact electricity.

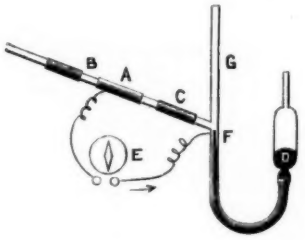
In his discussion of electrical boundary layers, Helmholtz† starts from this analogy. If two different bodies come into contact, there arises a potential difference $V_1 - V_2$. Let the charges of the electrical layers which are thereby formed, per unit of surface, be σ and $-\sigma$. If their distance apart be a, then we have $\sigma = (V_1 - V_2)\, 4\pi a$. If the bodies could be separated without discharge, the surfaces must retain the charges σ and $-\sigma$. As a matter of fact, a partial discharge always takes place, which in the case of conductors is almost complete, but, if one or both of the bodies is an insulator, a very considerable charge is retained.

To show the consequences of this idea, we shall make the following experiment. Let A, fig. 1, be a metal plate; B, a metal rod, and C, an insulating handle. We coat the plate, A, with an insulating material, H, for example, by dipping it in melted pitch or resin. A glass dish, D, is filled with mercury, and the mercury as well as the plate, A, are connected to the poles of a galvanometer, E. I used a Kelvin galvanometer with a resistance of 6,400 ohms, which gave a deflection of 1 cm., with a discharge of 100 electrostatic

* *Wied. Ann.*, 53, p. 401, 1894.
† *Wied. Ann.*, 7, p. 335, 1879.

units. If now the surface of the pitch is brought in contact with the mercury, no deflection whatever takes place on the galvanometer, but when they are separated a very considerable deflection is obtained, even though the surface of contact is only a few square centimetres. The current flows from the mercury through the galvanometer to the metal plate.





Figs. 1 and 2.

According to Helmholtz, this experiment is to be pictured in the following way. When contact is made, the mercury takes a potential V_1, and the pitch a potential V_2, at the surface of contact. An electric current now flows through the galvanometer, till the plate, A, is brought to the potential V_1. Let a' be the thickness of the coating of pitch, and K the coefficient of induction of the pitch, then the surface density σ' at the surface of contact between A and H will be approximately

$$\sigma' = \frac{K (V_1 - V_2)}{4 \pi a'}$$

Here $V_1 - V_2$ is certainly small (not more than a few volts), and a' is a finite quantity; σ', therefore, is of inconsiderable amount, and the current in this case will not be indicated by ordinary measuring apparatus. We can now, therefore, make the statement, *no electric current is produced when an insulator is brought into contact with a conductor.*

If we now raise the plate from the mercury, the pitch becomes negatively electric. If no reunion of the charges takes place, the surface density must have the value

$$\sigma = \frac{V_1 - V_2}{4 \pi a}$$

A corresponding quantity of electricity must, therefore, flow through the galvanometer to the plate A, and the ratio of the currents at contact and on separation, to each other will be $\sigma' : \sigma$, or $K a : a'$. As a matter of fact, partial reunion takes place and the ratio is not quite equal to $\sigma' : \sigma$.

If we bring the pitch again in contact with the mercury the pitch again shows a deflection; the current now goes from the metal plate through the galvanometer to the mercury; this current is usually much smaller than the separation current, in the case of pitch about one-third, in other cases it may amount to two-thirds. The diminution is due partly to leakage into the air and partly to absorption by the dielectric.

As the results obtained with the above apparatus were somewhat uncertain, another form, illustrated in fig. 2, was devised. B, C, is a glass tube 10 to 15 cm. long, the inside diameter being 3 to 6 mm. The tube is coated inside with the insulator to be investigated, either by dissolving in some solvent such as benzol or carbon disulphide and sucking the solution into the tube, or by melting the insulator and coating the inside of the tube with a thin layer. Round the middle of the tube a strip of tinfoil, A, is wrapped, covering about 4 to 6 cm. of the tube. The tube, A, B, is connected to a T tube, F, G, by a piece of India-rubber tube. A mercury reservoir, D, is connected to F by a length of India-rubber tube, sufficient to allow the reservoir to be raised and lowered. A platinum wire is melted through the tube, F, to put the mercury in the tube in contact with one pole of a galvanometer, E, the other pole of which is connected to the tinfoil strip, A. With this apparatus, the experiments above described can be easily repeated. By raising D, the contact between the mercury and the insulator in the tube is made; by lowering D the separation takes place. When the tube at B is open, we obtain the same results as with the first apparatus, since the experiments in both cases are made in atmospheric air; but if we bring in another gas through B and out through G, the circumstances are partly different, as will be seen further on.

Numerous experiments were made with this apparatus with a considerable number of different insulators such as pitch, resin, sealing wax, shellac, dried turpentine, mastic, paraffin, camphor, &c., which were coated on to the inside of the tube as already described. These insulators were tested in atmospheres of air, of hydrogen, and of carbonic acid gas.

Pitch, in atmospheric air, always becomes negative when in contact with pure mercury. But in an atmosphere of hydrogen, which has been thoroughly freed from oxygen, pitch becomes positive. Before this experiment succeeds, the pitch must be warmed sufficiently to give off any oxygen which may be adhering to its surface. The other insulators tested, all behaved very much in the same way.

These experiments all showed the importance of the presence of oxygen in the development of electricity by the contact between mercury and insulators. If we hold by Helmholtz's theory, according to which frictional and contact electricity are essentially the same, we can now understand that a body when rubbed with a given substance may become sometimes positively, sometimes negatively electric; it all depends whether the oxygen is removed by the rubbing or not. Also it can be understood why two apparently identical bodies when rubbed may become differently electrified.

The insulators investigated were all combustible, and there can be little doubt that a layer of oxygen was condensed on their surface. It is well known that in glass tubes in which mercury is often raised and lowered, a gray powder is formed under the action of atmospheric air. This probably consists, chiefly, of a compound of mercury and oxygen; this compound I shall here designate as HgO, though, possibly, there are other compounds, perhaps Hg_2O. I believe that in the experiments that have been described in presence of oxygen, a small quantity of this compound is formed when mercury is brought in contact with an insulator. We have then the scheme

$$\overset{+\ -}{\text{Mercury, HgO, pitch.}}$$

$\overset{+}{\text{Hg}}$ being the cation, and $\overset{-}{\text{O}}$ the anion, in the compound, HgO. On separating the mercury from the pitch, the oxygen anion remains with the latter, the Hg cation follows the mercury, and we now have the scheme

$$\overset{+\ -}{\text{Mercury Hg, O pitch.}}$$

According to this, therefore, the pitch becomes negatively electrified because it is covered with oxygen anions, and a positive charge is produced on the mercury through the presence of mercury cations. Free electricity has no more existence here than it has in the case of other methods of producing electricity.

After considering the whole of the experiments, I have come, without hesitation, to the conclusion that friction by itself does not excite electricity; the effects which are usually ascribed to friction arise from chemical decomposition, which is initiated on contact and consummated on separation. The formation of double layers assumed by Helmholtz is to be looked upon as a polarisation of the double atoms of the molecule, wherein the cations form the positive and the anions the negative layer. On separation the cations are left adhering to one body and the anions to the other body, and thus the bodies receive their electrical charges. This theory agrees with the views developed by Helmholtz in his Faraday lecture. According to him, every atom has a certain charge of electricity, depending on its size, which may be either positive or negative according as the ion makes its appearance as a cation or an anion; the combination of the two make the electrical neutral molecule.

It appears to me, therefore, to be now necessary to start from the view, that electricity can never exist outside the atom. This circumstance must also be taken into account in electro-magnetic and thermo-electric theories; where electricity is moved, ponderomotive forces must co-operate; their effects may not be perceptible in the ordinary sense, but they must always be taken into account in fundamental investigations. I believe with Geise that conduction takes place in the metals by means of ions. The connection between the conduction of heat and electricity seems to support this view.

I shall indicate some of the consequences of the views here developed. In static electricity it is usual to distinguish between insulators, semi-conductors, and conductors. It would be more correct to have four groups. I. Insulators or dielectrics, *i.e.*, bodies in which the ions are either immovable or can only oscillate about their position of equilibrium. II. Metals in which the ions either are freely movable or at least readily exchange their charges. III. Electrolytes, in which the atoms can move with more or less friction. Here glass is specially to be considered. IV. Bodies, analogous to water, which contain none or very few ions, but which in themselves permit the motion of ions. I name these Hydrides. Such substances are India-rubber and gelatine.

By the foregoing experiments it has been shown that metals, or their amalgams, make all the bodies of the other groups positively electric, if there is no oxygen present. Also, we are justified in assuming that electrolytes, such as glass or waterglass, will electrify bodies of the first and especially of the last group; everything will depend here on the motion of the ions; if, as is usual, the cation is the most easily moved (it possesses according to Nernst the greater osmotic pressure), the hydride will become positively electrical.

The important part played by oxygen in these experiments is no doubt due to the ease with which its molecule can be dissociated, as exemplified by the formation of ozone, and by many other phenomena.

I propose to discuss further consequences of the views here developed in a future contribution, more especially with regard to contact electricity and capillarity.

THE ROYAL SOCIETY AND ITS CRITICS.

In these democratic days there is no institution, however ancient, that can escape "the fierce light that beats upon" queen and commoner alike; we are not surprised, therefore, to observe that the illustrious Royal Society is no exception to the rule. However bitterly those who at present wield the power and manipulate the elections to the fellowship may resent interference, or rather criticism, we conceive it to be a great good thing that there are those who have the courage to indicate abuses when they believe them to exist. The recognition of an abuse is the first step towards its removal, and when the leading authorities in any learned society know that their deeds may be questioned, they will intuitively walk more circumspectly, and a healthier tone will consequently prevail. Of course, it is an old truism that to attack is much more easy than to repel, and that an accuser should ever be listened to with distrust. *Difficilem oportet aurem habere ad crimina.* But those who belong to a society existing solely for the discovery and upholding of truth, should be the last to discourage criticism, since the real object of every scientist should be to court investigation, whether it be hostile or friendly.

The correspondence which has been going on in the *Times* and elsewhere, anent the oligarchical tendencies of the Council of the Royal Society, may well suggest the question whether those who now, in virtue of the power of office, practically represent the Society, are not going back upon its traditions. Ever since its foundation in 1662 it has generally been a nucleus round which has clustered the scientific genius of Great Britain. In the earlier years it helped to fan the few glowing sparks of the desire for truth into a broadening blaze. It brought together those who were in sympathy through their devotion to knowledge, and who, in their union, found strength and encouragement. By the interchange of their ideas, thought was quickened, and the progress of science assured. By the publication of original papers new discoveries were placed on record, and thus preserved from being lost, as had too often happened before; whilst the discussion of these papers helped more thoroughly to sift the evidence on which the conclusions were based, and promoted increased accuracy and simplicity of thought and expression. Research, too, was stimulated by the increased definiteness of boundary between the known and the unknown. Before the Royal Society came into existence, the magic-mongers, who used to pose as "men of science," were accustomed to produce their questionable results in mystical folios, the copies of which became dispersed or lost. It was almost impossible to tell to what extent any subject had been investigated, and hence arose much repetition and delay. The Royal Society altered all this, and, moreover, encouraged genuine research by awarding grants of money to defray the expenses of those investigations which seemed worthy of such aid.

Bearing in mind the comparatively narrow outlook of our predecessors, it is surprising that there should have been so much single-mindedness exercised in regard to the election to the fellowship. Doubtless there were many unworthy recipients of these honours in the days that are past, but it is certain that the spirit which pervaded these elections was right. No genuine discoverer could escape the recognition which his work entitled him to; and, always bearing in mind that we are now living in a more enlightened age, and making due allowances for the limited horizon which was possible to scientific men fifty or a hundred years ago, does it not become painfully and deplorably evident that we are not keeping up the old traditions? The Royal Society to-day appears to possess, as the old philosophies would say, too much *vis inertiæ* and too little *vis viva*.

The chief charges now being brought against the Royal Society in the recent correspondence in the *Times*, are those which in previous years we have frequently had occasion to make. It is beside the point for the Council to complain that their motives are being impugned. No one doubts their honesty, either individually or collectively. The fault lies with the constitution of the Society itself. The statutes of the Society permit the following procedure in the election of council and officers:—The existing Council nominate 11 of their own body, and 10 Fellows who are not members of the existing council, whom they recommend the Fellows to elect as councillors for the ensuing year; and the President and other officers are nominated by the old council out of the proposed one. Now the practical effect of this procedure is to deprive the fellows of the power of choosing their own governing body, and to place the government of the Society in the hands of a certain set. (We purposely avoid the use of the words *clique* or *ring*, though we are not sure that either would not be justifiable.) Although it is legitimate for any fellow to nominate candidates for these offices, it is hopeless for them to attempt to place their nominees, since they have neither the facilities nor the coherence possessed by the Council as a body. We need not suggest the effects of this procedure.

Again, there is no provision for the compulsory retirement of councillors after a certain number of years of service, nor, indeed, for the retirement of the officers of the Society. We recognise that it would be undesirable that the officers should be changed too frequently; at the same time there should be a limit. It is most essential also that proper checks should be established for preventing the officers from acquiring an undue amount of power, so that fellows may be in a position to remind them that they are their servants, and not their masters, and that they are simply put into office to transact certain business which it would be inconvenient or impossible for the whole body of fellows to transact for themselves.

Amongst the suggestions which have been made to meet these difficulties are that no councillor (other than the treasurer and secretaries) should hold office for a longer period than five years; that retiring councillors should not be eligible for re-election until the expiration of one year; that only five councillors should be bound to retire in each year; and that two of their successors should be proposed by Fellows who are not councillors. This last provision exists in many London clubs, and works well in practice. It has also been suggested that a new statute should be established,

limiting the term of the presidential office, and enacting that successive presidents shall be representatives of different branches of science.

But by chapter xvii. of the existing statutes, the power of alteration is vested solely in the Council! Nothing could more completely illustrate the oligarchical character of the Society's constitution. It is true that chapter xii., section 2, enables any six Fellows to require a general meeting to be convened; but having regard to the provisions of chapter xvii., it is very doubtful indeed whether such a meeting could make any alteration in the statutes. A reform is urgently needed, giving the Fellows power to alter the statutes, and providing that all new statutes, or alterations of existing ones, shall be submitted to a general meeting, with full powers to amend any proposals brought forward by the Council.

The gravest charge of all, perhaps, which can be brought against the Royal Society relates to what, to put it mildly, we may call its *exclusiveness*. And this we do not for a moment attribute to deliberate purpose so much as to a condition of things which takes its origin in the constitution of the Society itself. Whilst we would not care to march with those who claim that the professors are, as a rule, mere book-men, and not the foremost in advancing the true progress of science, it is a lamentable fact that a professorial chair at present is the easiest means whereby to obtain the coveted distinction of the fellowship of the Royal Society. Professors are but human, and it is only natural that those who constitute so large a proportion of the existing Fellows should be inclined to favour the claims of their brethren, without the pale, for honoured recognition. No one would begrudge the professors their self-bestowed laurel wreaths if they were disposed to share them with those despised "practical men," who, instead of spending their lives in the soul-narrowing occupation of trying to impart to others the few grains of knowledge which they have garnered themselves from the labours of others, have been engaged in epoch-making discoveries and inventions which make their mark in the great industries of the world, and enrich the resources of civilisation.

Royal Society "exclusiveness" finds expression in many ways besides the elections of council and elections to the fellowship, *e.g.*, there is the tardy and apparently reluctant distribution of honours to those who often, in the opinion of the whole scientific world, saving the Council, have won them years before they ever received them. Then, again, there is the "alienation to other societies" of papers that should have been secured by the Royal Society, of which complaint was made a little while ago. What is the reason if it is not to be found in the "exclusiveness" of the Society itself, which leads an author to prefer the critical atmosphere of the more active societies to the upholstered vacuity of the Royal Society's rooms? The president has deplored in guarded, but quite unmistakable language, the growth of other societies which absorb much of what once went to the Royal Society. He has even admitted the danger that the Royal Society may have to confine itself to sciences which have no society of their own, unless, indeed, it accepts the humble rôle of publisher to its rivals, or like the London University, concentrates its energies upon assigning honours, diplomas and so forth upon those who have done their work elsewhere. Nobody wants the Royal Society to publish the whole of the scientific work, even of members of its own body; it has published a great deal too much which is not of permanent value, with the result that it now finds itself in parlous financial straits.

For all these defects and weaknesses there are two remedies, which should follow each other in their application. The first is a revision of the statutes in such a way as to bring the machinery for managing the Society up to date; and the second is really a natural consequence of the first, and would be evolved from it. It consists in invigorating the governing body with "new blood," that is to say, with men who are sufficiently in touch with certain large departments of scientific work which now obtain scarcely any encouragement or even recognition at the present day at the hands of the Royal Society. Could this consummation be realised, we believe that all the abuses which are now so justly complained of would gradually be eliminated, and the Royal Society would once again hold that position of influence, and receive that profound respect which, bearing in mind the objects of its foundation, it should be entitled to.

SMALL DYNAMOS: THEIR CONSTRUCTION.

From time to time we have letters from students, mechanics, &c., inquiring for information regarding difficulties they meet with in making small dynamos. Generally they apply to us after their designs have been carried into practice to a large extent, so that the hints we are able to throw out, based upon the meagre information sent, are generally more or less futile, as the magnets, cores, and other materials are already made and cannot be altered.

Some time ago, August 21st, 1891, we gave a full description of the design for a small Edison dynamo, but it was too elaborate for amateur purposes, and, judging from the many inquiries we have had on the subject, that particulars of a good design for a dynamo of about one horse-power would be useful to many, we propose to give the details of a small machine of simple construction, designed specially for us by a practical electrical engineer.

The machine will be equally applicable as a continuous current dynamo, 100 volts 8 ampères output; as a motor of same input, giving about ¾-H.P. at pulley; as an alternator, giving 70 volts and 8 ampères, in single phase of 30 ~ frequency; as an alternator, giving two currents in quadrature phase; as a converter of continuous into alternating currents; as a convertor of alternating to continuous currents; and as a convertor of multiphase to continuous current.

Such a machine is worth making, and with two of them the whole practice of electrical engineering on the alternating continuous and multiphase systems can be actually demonstrated.

As the machine may be required as a launch motor, its design will be as light as possible compatible with efficiency and speed limits.

We shall give two windings, one for high speed and large output, and one for slow speed and small output.

Machining of parts is absolutely necessary, but will be reduced as far as possible in the design. The field magnet as a rule is the most difficult job for the amateur. It requires a good stiff lathe to bore out the armature tunnel of even a small dynamo; but the field magnets had better be ordered bored out at the foundry. Most steel founders can include the boring in the price charged for the magnets.

Iron stampings and metallic spiders and fittings are now universally used, but the student or amateur who can go to the expense of and undertake the working up of these materials could very likely buy a ready-made machine right off; for experimental purposes, and to meet the requirements of students and amateurs who cannot afford all the refinements of the high-class workshop, a cheaper construction must be adopted.

A construction well within the capacity of a foot lathe above 3½ inch centres, with the usual simple hand tools, drills, taps, and a vice, is what is required, given the field magnet cast and bored.

To meet this demand we must fall back upon earlier methods, and use wood to some extent instead of metal. It must not be thought that these cheaper methods and materials will produce a less effective machine. For the purposes to which a student or an experimenter uses a model, such a machine is quite as useful as one in which all the later mechanical refinements are introduced. The only requisite in such a model is that the parts shall be properly dimensioned, so that the machine, although not so durable and elegant as one upon which high-class engineering skill in construction has been expended and the finest materials used in its parts, will be useful, and give a good account of the energy passed through it.

The best scientific work and much of the most interesting original research has been carried out by home-made, rudely-constructed apparatus, but if historical collections are closely studied, it will be readily seen that however rudely made and unfit the materials may seem, the design of successful experimental appliances has been very perfect.

A glance at Faraday's or Dalton's apparatus, and at James Watt's early engines show all this to be true.

On the other hand, well made beautifully finished machines of the finest materials are to be seen in plenty in which the dimensions of the parts are out of proportion and the design bad.

Iron stampings are not difficult to obtain, but they are difficult to mount and set up without special tools, such as

few can get and still fewer use. We shall, therefore, employ a wound up iron wire core of the early Siemens type, many of which are still in operation and have run for years in hard daily work.

The bearings must be self aligning and held in hard-wood pieces, which also hold the brush spindles, terminals, &c.

The commutator will be of disc form, with flat headed screws for contacts and fixed carbon brushes, so that as a motor or converter the armature may run in either direction. Copper brushes may also be used if desired.

With the exception of the field magnet the whole of the materials may be bought readily almost anywhere, so that patterns and castings need not enter into the design. And, as it may be well worth the attention of a steel founder or dealer in soft steel magnet castings to get up the pattern and offer the magnets ready bored for sale at a fair price, even the difficulty with the magnet pattern may disappear. This matter will be brought before the notice of those who are in a position to deal with it.

We will at first give a very elementary outline of the calculations required in finding the necessary dimensions, using the formulæ of Mr. Kapp without going into any mathematics or any intricate refinements, as even the calculations may be only approximations and yet be near enough in practice.

The student will start with the armature and design the rest of the machine to fit that very active part of it, just as a steam engineer has to consider his steam cylinder and make the rest of his engine to correspond to that.

There is a limit to the small size of dynamos below which they will not excite themselves, and, further, there is very little use for very small machines. If a machine is worth spending time and labour upon, it must be of some utility when finished. Those who cannot handle a machine of about one horse-power and desire a much smaller apparatus, ought to build a magneto machine; it is certain to excite, and be much more efficient than any smaller dynamo.

CORRESPONDENCE.

Electricity in Mines.

I notice you have quoted my letter to *Engineering*. Since writing it, I learn that the current used was continuous, and 500 volts.

This, I think, deserves a little discussion. The man was lifting a hutch (which is Scotch for waggon) on to the road, his skin was most probably moist from perspiration, and he would have, I should think, one foot on the rail. As the tub was raised, it would sway to one side, and his head make contact with the wire; and this, from a mining point of view, is only a matter of daily occurrence.

The manager says they think the man must have had a heart in a poor state; that is most likely true, and I hope means were taken to ascertain if it was so.

If my surmise is correct as to the facts, he was undoubtedly in a position where the greatest possible injury would be done to him, striking him in the head, passing through his body, and out from his foot to the rail; I must say I am surprised that such a current should have held him until the machinery was stopped.

As a user of electricity, I have implicitly accepted, and still do so, the report of the New York Health Committee, given in *The Engineer*, December 20th, 1889, which says:—"It is our opinion, based upon our own experiments and authentic records of the experiments of others, that an alternating current of 250 volts is dangerous to the life of any person through whose body such current might pass; also that a continuous current of 700 volts is, in like manner, an unsafe amount of electrical force to be permitted to be used upon an imperfectly insulated wire."

I am quite aware that much stronger currents are said to have been received by persons which did them no harm; but did the current pass through them from head to foot, and what connection had their feet with the earth?

The report of this accident says "his head touched a defective casing." I hope we shall learn what the word "casing" covers, for we are all interested in learning the full facts of the case.

In mines, as I endeavoured to point out, we have circumstances which require special watchfulness. Darkness, a low height, which keeps the cables in many cases only a few feet from the floor, serious consequences if a fire should break out in the long passages, often unseen for several hours, and a lot of workmen entirely ignorant of everything electrical. For instance, a short time since some blasting powder was ignited in a roadway where the cables are hung, the under-manager was asked if they had taken any harm. "Oh, no," he said, "I passed my hand along both of them."

Now, it is no use going like a bull at a red flag against any one who raises such questions as I did at the British Association. I have taken and read the REVIEW for many years, and if the spirit of fairness and the desire to have no fear of the truth, which I have found to prevail in its pages, was more general amongst those who are anxious to see electricity prevail, it would be much to their interest.

A. W. Steavenson.

Speed Indicators.

We see in your issue of the 14th that Mr. Dudley Barlow is inquiring about the subject of automatic working speed counters, combining a chronograph and a revolution counting device.

We have ourselves made a considerable number of speed indicators, consisting of a chronograph and a portable counter mounted on a handle, and having an axle running through the two carrying a steel triangular point at one end, which can be pressed against the end of a revolving shaft; when this axle is pressed hard against the shaft the gearing of the counter engages and the chronograph starts off; after any desired interval, as noted on the chronograph, the whole arrangement can be withdrawn and the number of revolutions noted.

This arrangement seems to be what your correspondent refers to. Another simple combined chronograph is one of American design, known as Eddy's. In this instrument a small watch movement is wound up sufficiently to go for 30 seconds by pressing in a pin, the same motion setting the counting hand to zero. The end of the counting axle is pressed against the revolving shaft, and when all is ready, a second small pin is depressed, and the counter then records during the time the watch movement is in action, *i.e.*, 30 seconds; when the watch stops the counter is disconnected, and the graduation of the dial is arranged to show the number of revolutions in 60 seconds.

There is also on the market for approximate indications of speed, the Young's speed counter, and another simpler portable strophometer of our make. These instruments show at a glance, by a pointer on a dial, the number of revolutions of the shaft, without the necessity for using a watch.

Elliott Bros.

Mr. Wm. J. Sowter also writes mentioning the indicator made by the Eddy Electric Manufacturing Company, Windsor, Conn.

We have received several other letters in reply to our correspondent's enquiry last week. Mr. T. W. W. Melhuish, of Vienna, says, "I obtained, five years ago, such an instrument as Mr. H. Dudley Barlow asks for, from M. E. Deschiens, 123, Boulevard St. Michel, Paris."

Messrs. O. Berend & Co. write, "We are just on the point of bringing out a speed counter and chronograph on the system of our May's patent revolution counter. The instrument has the shape and size of an ordinary watch. It is direct reading, whether the spindle turns to right or left, and the chronograph reads to $\frac{1}{5}$th of a second, and is non-magnetic."

Re Folkestone Electric Lighting.

I write to remind you that the Folkestone controversy was initiated by your accusing me of being deficient in professional etiquette. The justice of the charge I denied and still most emphatically deny.

By publishing in your last issue a private letter without my sanction or previous knowledge, your correspondent, Mr. Mark Parker, has demonstrated his ignorance of even the common courtesies of life. Had he asked my permission before publishing my letter I should readily have granted it, for a perusal of the letter will clearly show that I was prompted to write it by only the kindliest and most sympathetic of motives, and I am not aware of having done or said anything in connection with this matter that will not bear the strictest impartial investigation.

F. H. Medhurst.

December 19th, 1894.

Accumulators for Tramcar Traction.

In the last issue of your valuable Journal, you comment upon the paper read by Mr. Gibbings before the Northern Society of Electrical Engineers in a manner which, in my opinion, is unjust and unfair to the accumulator system, ignoring all the progress made during the last few years.

Starting upon wrong premises, and stating wrong facts, it is only natural that the conclusions drawn should be utterly wrong.

You state that the storage battery depreciates too rapidly to allow of this "remunerative" system being realised; while actual experience has proved that even on a line with steep gradients, the depreciation of certain accumulators is covered by a small fraction of a penny per car mile run. Again you say: "Taken with the great cost of working battery traction, it is a hopeless case." I grant that on several lines where accumulators were used the financial results were unsatisfactory, but this was owing to circumstances with which the batteries had absolutely nothing to do. Permit me to assert—and I am prepared to prove this and the other contentions which I advance here—that traction by means of accumulators, if properly managed, is not dearer, but in many cases cheaper than by any system of long-distance transmission, and that the case, so far from being hopeless, is very hopeful indeed.

The advice which you are good enough to offer Mr. Gibbings, viz., "catch your accumulator," is no doubt sound, but it may be that Mr. Gibbings has done so already, although he may have omitted to apprise you of the fact.

"Besides depreciation, the capital sunk in batteries has to be paid for." True, but inasmuch as capital sunk in other electrical systems has also to be paid for, and provision to be made for depreciation, and, moreover, as the first outlay with an accumulator line is considerably less than with a system of transmission from a long distance, the balance is very much in favour of the accumulator system.

The assertion that three or four batteries are required for each car emanates evidently from a source either ignorant of accumulators or desirous of hiding its knowledge. The batteries can economically be charged as rapidly as discharged; two sets per car are sufficient for the purpose of traffic, and a reserve of one set between two cars is ample.

"The cells would require to discharge up to 150 ampères." Just so, and I may say that on a certain line up to 180 ampères under ordinary conditions of the road, and up to 210 ampères with snow on the rails, and where's the harm? The batteries did it, and their depreciation, as mentioned before, is covered by a small fraction of a penny per mile; so that scarecrow will not answer.

"The cars carrying the accumulators weigh much more than trolley cars—say 2 tons more." Rather say not quite $\frac{3}{4}$ ton more (and this in a car for 52 passengers with a total weight of over 10 tons, being about 8 per cent. of the total weight), and you will be nearer the mark.

"These are all well worn objections." Bravo! Indeed, so well worn are these objections that they are now well nigh worn out.

"In practice we have only to deal with facts." This remark I fully endorse. Facts I have asserted, and as facts I have proved them, and will prove them over and over again to anyone interested in the question.

The "dreams of the future" dreamt years ago have become realities of the present day, and must, as such, be recognised by friend and foe alike.

L. Epstein.

November 17th, 1894.

The Design of Small Dynamos.

Would you kindly say what would be the voltage, and how many ampères may we expect from the following dimensions of an upright Kapp dynamo when running at 1,600 revolutions per minute:—

Armature resistance (running), ·165 ohm; conductors on armature 276 in two layers, $4\frac{1}{2}$ lbs. No. 16 D.C.C.; length of core, 8 inches × $4\frac{1}{2}$ inches diameter (drum), built up with soft iron washers $4\frac{1}{2}$ diameter with $3\frac{1}{2}$ hole, insulated from each other with thin paper.

Series coils, 9 lbs. No. 12 D.C.C., estimated to be 53 turns on each magnet.

Shunt, 30 lbs. No. 22 D.C.C., to give 3,174 turns on each magnet.

Field magnets, cast-iron, 8 inches × $2\frac{3}{4}$ inches × 7 inches long, with massive yoke and pole pieces of much larger section, tunnel bored out 5 inches. Length of magnetic circuit (not including armature), $20\frac{1}{2}$ inches.

We wanted to get 105 volts and 15 ampères.

Anxious Student.

[The volts you may expect to obtain can be estimated as follows:—n^t = turns of wire on armature, n = the revolutions per minute, z total magnetic flow through armature in Kapp lines per square inch. Then $E = z \times n + n^t\ 10^{-6}$. In your case n^t equals 276, n = 1,600, and z can be roughly estimated from the length of armature core, and its section in this case 8 + 1 = 8 square inch section. You cannot expect more than 20 lines per square inch in such a core, so that z, at a maximum, will equal 160 lines. Now, $276 \times 1{,}600 \times 160 = 70{,}656{,}000$, and by the 10^{-6} we simply strike off six figures, beginning to count from the units, or right hand end, this leaves us 70 volts as the maximum you can possibly get if all is perfect. The weak spot in this machine is the small cross section of the armature core, only 8 inches counting the two sides. It can carry only 160 lines, while your magnets can carry 190. Probably, about 60 volts is all you will get. The current, as you may expect, is limited only by the section of the copper wires in the armature. Double No. 16 B.W.G. would carry 15 ampères, but that is about its maximum; and the machine would spark badly with this current, owing to the weak field strength. You wanted a 2-horse machine, but have really got only 1 horse-power dimensions.—Eds. Elec. Rev.]

Obtaining Continuous from Alternating Currents.

Can you inform me as to how an alternating current—E.M.F. 100—can be transformed into a continuous, or practically continuous, current?

I understand that this can be done by the addition of certain rings' brushes to an ordinary continuous current dynamo, but that there are several drawbacks to the method, one of which being the fact that the dynamo is not self-starting.

I am wanting the continuous current for medical purposes, and I should be very much obliged if you could give me any information on the subject. I enclose my card, and, thanking you in anticipation, beg to subscribe myself

Student.

[There are many ways of obtaining a continuous from an alternating current. For medical purposes, the machine our correspondent mentions is used with a small storage battery, so that there is no difficulty in starting. A self-starting

induction motor coupled to a small dynamo is another successful method, and is, perhaps, the simplest.—EDS. ELEC. REV.]

We have received a letter on "Theory and Practice in Electrical Engineering," also one on the "Abuse of Exhibitions," but these we are compelled to hold over until next week.

LEGAL.

SHELFER *v.* CITY OF LONDON ELECTRIC LIGHTING COMPANY, LIMITED.—MEUX'S BREWERY COMPANY, LIMITED *v.* THE SAME.

ON the 26th November, LORD HALSBURY and LORD JUSTICE LINDLEY, sitting in the Court of Appeal, reserved their judgment in the matter of the Appeal brought by the plaintiffs from the orders of Mr. Justice Kekewich of the 19th April last. On Tuesday their Lordships delivered their considered judgments.

LORD HALSBURY said the plaintiffs were the lessees and reversioners respectively of premises known as the Waterman's Arms, Southwark, and they both complained of nuisance and injury by the vibration caused by the working of the engines used by the defendant company in the generation of electricity in premises near the Waterman's Arms. The nuisance was proved as a fact; it was also established by the evidence that the nuisance would increase if the defendants were permitted to increase their machinery and operations as they proposed to do. The plaintiffs asked for an injunction, but Mr. Justice Kekewich, holding that the nuisance was established, came to the conclusion that it was one of those cases in which he was justified in referring to an Official Referee the question of damages sustained respectively by the plaintiffs. The plaintiffs thereupon appealed and it was argued on their behalf that they were entitled to an injunction. On behalf of the defendant company it was argued by Mr. Moulton that the defendants were authorised by law to carry on their business; and that after they had done all they could to prevent a nuisance they stood in the same position as a railway company, which was not only entitled but authorised to run trains, notwithstanding any vibration, or damage, or annoyance which they might cause. If that contention were right his Lordship would still not be able to go so far as to say that the defendant company, like a railway company, had exhausted all possible means for minimising nuisance arising in carrying on their business. It was not, however, necessary to go into that part of the case as the powers of the defendant company were defined by statute. It was necessary to construe Sections 10 and 17 of the Electric Lighting Act, 1882, with the provisions of the provisional orders, 1890-1, granted to the company. The material words of the provisional order were: "Nothing in this order shall exonerate the undertaking from any indictment, action, or other proceeding, for a nuisance, in the event of any nuisance being created by them." The General Act only gave them power to carry on business subject to the restrictions of the provisional order, and the provisional order rendered them liable to an indictment, &c., for nuisance. Secs 10 and 17 of the Electric Lighting Act, 1882, referred to damages done in the construction of the defendant's works and not to damage subsequently done by working the defendant's machinery, and the evidence as it stood did not satisfy the Court that the nuisance could not be reduced if the defendants multiplied their stations and diminished the power of their engines at each station. Assuming the nuisance to be established, was there any authority depriving the plaintiffs to have an injunction? Had it not been for Lord Cairns's Act no one would have argued that the plaintiffs were not so entitled, and it now became necessary to see whether Lord Cairns's Act had given a power to the courts to award damages instead of granting injunctions where plaintiffs insisted on their rights to have injunctions? His Lordship held that the Act did not confer any new powers on the Courts where serious nuisance was proved, but his Lordship disagreeing with this view said the judgment of Mr. Justice Kekewich must be modified so far as the injunction was concerned, and an injunction must be granted. So far, his Lordship said, his observations applied to Shelfer's case. It was argued that Messrs. Meux, as reversioners, had no such right; but it was impossible to deprive the reversioner of his right to an injunction where it was proved on the evidence that permanent injury had been done to the structure of his premises, and that the injury would increase if the vibration was continued. Messrs. Meux were entitled to damages in respect of past injuries, and to an injunction in respect of the nuisance.

LORDS JUSTICES LINDLEY and SMITH concurred, and the appeals were allowed with costs.

Mr. Warmington, Q.C., Mr. Badcock, and Mr. Waggett appeared for the appellants, and Mr. Moulton, Q.C., Mr. Renshaw, Q.C., and Mr. Braithwaite appeared for the respondent company.

MUIRHEAD *v.* COMMERCIAL CABLE COMPANY.

THE Master of the Rolls and Lords Justices Lopes and Rigby, sitting in the Supreme Court of Judicature, on Tuesday last, delivered a deferred judgment in this case, which was argued before them through four days at the beginning of last month on appeal from a judgment of Mr. Justice Kennedy.

The action, which was heard by that learned judge, without a jury, through seven days in March last, resulted in his finding for the plaintiffs, on a deferred judgment, for £3,566 and interest, representing royalties claimed under an agreement giving the defendant company the right to use patents belonging to the plaintiffs in duplex telegraphy for the transmission of messages simultaneously over the same conductor. Practically, the point in dispute centred round the legal question whether inventions patented in America in 1880 were the same as had been patended in this country in 1876, the agreement for royalties being "for the period during which the patent should last." The defendants, in answer to the action, paid into Court £135 13s. 8d., representing royalties to July, 1891, when, they alleged, the patent ceased; but Mr. Justice Kennedy found against them, holding that the combination patented in the United States in 1880 was a new invention, and not that for which the English patent was granted four years before, and so gave judgment for the full amount claimed. Hence this appeal, which was argued by Sir Richard Webster, Q.C., and Mr. Fletcher Moulton, Q.C. (with them Mr. A. Walter) for the defendant appellants; and by Mr. Finlay, Q.C., and Mr. Bousfield, Q.C. (with them Mr. Pollard), for the respondent plaintiffs.

The MASTER OF THE ROLLS now said: In this case an action was brought upon an agreement by the defendants to pay certain sums of money so long as a certain patent should last. The matter related to two patents, one granted in America and the other in England. It seems to me that it was a mere waste of time to say that the claim depended upon what was the length of the patent in America, and that if it had run out the payments were not due. The case was tried before Mr. Justice Kennedy, without a jury. I have his judgment before me, and I am prepared to say that I have never seen a judgment, to my mind, more admirably written. He seems to me to have gone through the whole case step by step, to have stated every phase of it in perfect language without any superabundance of words, to have carefully considered each point, to have decided each of them fairly, and then to have come to his conclusion. His judgment is, in fact, to my mind so admirably written, that I don't know how I can add a word to it. My judgment in the case may be taken really to be the judgment of Mr. Justice Kennedy, and to be in the exact words he used, from beginning to end, because I don't see how I can differ from him. But I must, I suppose, refer to what seems to me some points in that judgment so distinct, so clear, and marked with such an absence of superfluity as to contrast with, and to prevent my drawing my mind from it to the volume of words poured upon us by way of answer to it. To that cloud of talk, it seems to me, I infinitely prefer the clear, and simple, and plain language of the learned judge. First of all, Mr. Justice Kennedy pointed out what is the law in America. It is there part of the statute law that every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time as the foreign country's patent, and that law is laid down in plain and simple language in the United States. Another point is that every patent granted there ceases and expires at the end of 17 years, but if the invention has been previously patented abroad, and the foreign patent expires before the 17 years have run out, the United States patent expires at the same date. Now, that being the law, Mr. Justice Kennedy has to determine what was the status of a patent which had been previously patented in a foreign country, that is, in England, and then he went on to point out that it was not necessary, in order to determine the rights of the patentee, and prevent the exercise by him of the privileges of the grant, that any judicial proceedings should be taken for the purpose. By the operation of the statute the United States patent was extinguished and expired, notwithstanding the terms of the grant, when the foreign patent expired. It then came about that the question the learned judge had to decide was this—was the invention which was patented in America in 1880 the same invention which had been patented in England in 1876; in other words, were the two patents for the same thing? Now what were the patents? That in America was for a combination, and it was so claimed in terms, a particular combination, exact in its details, and exactly described in the patent, and claimed as a combination, consisting in the relative position of certain things in the instrument which was to do the work, and the patent was for a combination of them by means of placing them in certain positions. That was the American patent. Now turn to the English. How can it be the same invention, unless the thing which was patented in America was for combination, and exactly the same combination? It seems to me, therefore, that we must uphold this judgment, unless we are prepared to say that the thing patented was for a combination, and for the same combination—even though it be for a combination that won't do, it must be for the same combination—and although the two patents need not be word for word, and comma for comma the same, they must be substantially the same. I have not heard the American patent described, but I am content to follow Mr. Justice Kennedy's description of it as a combination of old materials to new aims. As to the English patent, I look at it and fail to see that it is a claim for a combination; there is no claim of a combination in it, and in all the volume of argument we heard, we could not get any clear statement that what was intended was for a combination, and that combination which is now the American patent. It seems to me more than strange that if it was so we should have heard nothing about it; and it is equally strange that it was not so stated in the simplest terms. Had this been done, the case need not have lasted a quarter of an hour. If, then, anybody could have maintained that the English patent was a combination, and the same combination as the American, why was it not simply stated? But it was not. And if the English patent were a combination, why was it not so used; why not that placing of the materials used in the relative positions for applying them the moment after the patent was granted? It seems to be agreed by all the mechanicians and people who understood the thing that it was not so used until after the American patent was taken out. This was the testimony of people who must have known what they were talking about, of the most skilled wit-

nesses who could possibly be got, and who would tell the truth irrespective of the consequences. They said that the particular placing of the thing described in the American patent and claim was a combination, and the most useful thing that could be devised, enabling them to work the apparatus without friction and promptly and easily, and that they could not do before, during the time which elapsed between the English and the American patent, though they knew it was there, but they said they did not see it. I cannot bring my mind to put away the evidence, and to say, "I believe you; but I nevertheless think you are mistaken. That combination was in the English patent, although none of you could find it out; but it is not in the English patent so plain that a mere workman of ordinary skill must have found it out." To do this would seem to me to stamp these gentlemen with the most extraordinary oversight that could be imagined. Mr. Justice Kennedy seems to have accepted the view that a microscopic examination might have revealed some things in the English patent not claimed in the second patent; but, if so, they were not so described in language as that a workman of ordinary skill would find them out, and, therefore, the true construction of the English patent was that they were not there, and it was not a patent for that combination. If that be so, it cannot be the same as the American patent, which is for a combination and nothing else. I therefore come to the conclusion that Mr. Justice Kennedy was perfectly right in his judgment. If there were any doubt about it, I think he took the right view that the burden of proof lay on the defendants to show either a diminished length of the American patent, or that the combination in the English and the American were the same. I can see no fault nor blemish in his judgment, and I think the appeal against it should be dismissed.

Lord Justice Lopes: I regret to differ from the Master of the Rolls in the conclusion at which I have arrived in this case. I entirely agree with what he has said as to the admirable judgment of Mr. Justice Kennedy in the points of law, but I disagree with the view taken of the evidence. I have had an opportunity of reading the judgment which Lord Justice Rigby will now give as our joint judgment in the case, and the reasons which have led to the conclusions to which I have come.

Lord Justice Rigby then, assisted by copious written notes of the more technical part of the subject, proceeded to speak for nearly an hour, giving what he described as the joint judgment of Lord Justice Lopes and himself in the case, supplementing these written observations by passing verbal comments on many of the points raised in the four days' arguments before their Lordships, and by a free critical examination of the evidence given *pro* and *con* in the Court below. The case, he said, turned on one point, and one only—whether or not the American patent of 1880 came to an end when the English patent of 1876 expired. The question was one of American law, but the agreement between the parties provided that any differences arising under it should be decided by an English tribunal. His brother Lord Justice and himself did not think that Mr. Justice Kennedy's interpretation and application of that law, so far as it was material to this case, had been successfully impeached; and they agreed with the learned judge that a test of the identity of the patents was whether a structure made according to the English patent would infringe the United States patent. It was thus, upon the facts whereon the judgment below was based, that they (Lord Justice Lopes and himself) took exception; and as upon these Mr. Justice Kennedy, in his judgment, had not given them much assistance, he proposed to review the evidence given on both sides, and, by the aid of the diagrams and specifications, to state the grounds for the conclusion at which Lord Justice Lopes and himself had arrived as to the respective patents. His Lordship accordingly at great length, and with much detail, reviewed the evidence of the chief experts called on both sides, together with the drawings and specifications, adding that his brother Lord Justice and himself agreed with Mr. Justice Kennedy that the burden of proving the identity of the two inventions lay upon the defendants, and that the principle of introducing into any patent by implication any claim not expressly claimed therein ought to be applied with the greatest possible caution. As the result of their deliberations, keeping these points in view, they came to the conclusion that the defendants had made out their case affirmatively, leaving no room for the application of the principle that where there was a doubt it should be resolved in favour of the United States patentee. On these grounds they held that the judgment should be reversed and entered for the defendants, with costs.

On defendants' behalf, Counsel asked that these costs should be given on the higher scale, but Mr. Finlay, for the plaintiffs, objected, and called attention to their cross appeal.

The Master of the Rolls said he thought the position would best be met by, as the learned counsel had suggested, giving formal judgment against the plaintiffs in both cases, and then they could appeal from both if they thought well.

Mr. Finlay said he would ask for a stay of execution, and to this the Master of the Rolls said the Court could only say they must bring themselves within the rule.

With the observation from Mr. Finlay that they would give the usual undertaking, the hearing was concluded.

Grist and Another *v.* The Fowler-Waring Cables Company.

In the Queen's Bench Division of the High Court on Tuesday, before the Lord Chief Justice of England and a special jury, the case of Grist and another *v.* The Fowler-Waring Cables Company, Limited, came on for hearing. The plaintiffs were electrical engineers, carrying on business in the City, and they sought to recover from the defendants damages for breach of contract in supplying a telephone cable which it was alleged was unsuitable for the purpose for which it was required. The defendants pleaded that the cable was suitable, and further raised the point that any claim which the plaintiffs might have had against them had been settled by an action which had been brought in the Mayor's Court. On the latter point the plaintiffs contended that the settlement arrived at had reference to other cables than the one now in question. Plaintiff's case was that in 1891 he received certain orders for the fixing of telephones. One was from the firm of Anders & Co., and the wire was to run from Bush Lane, Cannon Street, to a point near the Old Kent Road. He saw a representative of the defendants with a view to their supplying a cable of 12 wires across Cannon Street Railway Bridge. At first one wire only of the cable was used, but subsequently a second customer was put on, and then came complaints of cross speaking. The defendants were informed of the induction, and ultimately a new cable was laid down which was, however, in work no more successful than the first. The defendants, on being written to, suggested the use of airtight terminal boxes, but no improvement was apparent, and the present action was consequently brought.

Mr. T. E. Gatehouse gave evidence to the effect that the cables put down by the defendants were wholly unsuitable for the purpose, no provision having been made to overcome induction. Each of the wires should have been covered with tin or lead foil, and the whole of them connected to earth. He agreed that twisted wires were now almost universally used to overcome induction.

On behalf of the defendants a number of witnesses were called, who stated that induction to a greater or less degree was unavoidable on the single wire system, and Mr. Channell, Q.C., in summing up the case for the defendants, denied any special warranty that the cable laid down should be free from induction.

In the result, the jury found that there was a contract by the defendants to supply a cable suitable for telephonic purposes; that there had been no breach of agreement; and, further, that the agreement between the parties in the Mayor's Court was in settlement of all questions relating to both the first and second cables.

His Lordship, on these findings, gave judgment for the defendants, with costs.

The Electrical Power Storage Company *v.* The Chloride Electrical Storage Syndicate.

In the Chancery Division of the High Court of Justice, on Friday, the 13th inst., it was arranged before Mr. Justice North that the motion in this action (which was reported in our issue of November 30th) should stand until the trial. His Lordship consented to see Mr. Justice Romer with a view of getting that learned judge to take the trial, but not before the 5th of January.

BUSINESS NOTICES, &c.

Urgent.—All names, addresses and advertisements intended for insertion in the Universal Electrical Directory of 1895 should be at once forwarded to the publishers, 22, Paternoster Row, London, E.C.

Ayr.—The Town Council have offered the Harbour Trustees a supply of current for lighting the Harbour at 4d. per unit, the trustees providing their own plant, lamps, &c.

The design of arc lamps, as submitted by Messrs. James Allan and Sons, has been adopted by the Police Commissioners.

Belfast.—The *Belfast Evening Telegraph* is responsible for the following statement, which appeared in its issue for 13th inst:—"We heard to-day a rumour of an intention on the part of some local electricians to compete with the Corporation in supplying electric light to a certain block of business houses not 100 miles from High Street. These gentlemen, it appears, have calculated that they could supply . . . . . current for all ordinary purposes at 3d. per unit; whereas, we understand the Corporation price will be 7d. per unit. The Council, it is stated, are a little jealous over this enterprise, and may exercise certain powers with regard to public thoroughfares should the scheme be carried out. The difference in price is very striking."

The resident engineer at the electric light station has been authorised to extend the electric main in Victoria Street to Messrs. Pullar and Sons establishment. He reported that he had been requested by the Asylum Committee to visit Purdysburn and report to them on the proposed electric lighting of the institution there. The Electricity Committee expressed the opinion that the application for his services should have been made to them in the first instance, and directed that an intimation to this effect should be sent to the Asylum Committee.

At the Belfast Lunatic Asylum the electric light is to be installed, the cost being estimated at about £1,300.

Blackburn.—The Town Clerk is to advertise for an electrical engineer to take charge of the Council's installation when completed, at a salary of £200 per annum.

The mains are to be extended from Sudell Cross to St. George's Church, and from Railway Road to Messrs. Dutton's Brewery. The question of carrying out the work with armoured cables instead of with vulcanised conduits, is left to the chairman and vice-chairman to deal with.

Brighouse.—There has just been completed in King Street a pile of business premises for the Co-operative Society. The new premises are lighted throughout by electricity, Mr. A. B. Brook, electrical engineer, of Brighouse, having carried out the work.

Bristol.—The Electric Light Committee has decided not to extend the electric light to Boyce's Avenue and Victoria Square, only one application for current from that neighbourhood having been received.

The Bristol Liberal Club, Corn Street, is to be equipped with the electric light.

Devonport.—The Council the other day, amid the confusion of excited debate, and a consequent storm of personal epithets, decided not to consent to the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order.

Dublin.—At the meeting of the Corporation last week the estimates of expenditure for the year 1895 brought forward by the Finance Committee included distribution of electricity £210, as compared with an estimate of £1,074 14s. 0d., and an expenditure of £80 16s. 3d. for the current year. The difference was stated to be due to the transfer of the larger items in the 1894 estimates to capital account. The electric lighting committee estimated a substantial increase in the revenue from private customers. Their receipts for the current year under that head were £7,218 15s., as against which they calculated they would receive £7,416 19s., and their estimate of income for 1895 was £9,712 10s.

Eastbourne.—The electric light was switched on to the parish church (St. Mary's) on the afternoon of Sunday, 9th inst.

Edinburgh.—The new premises of the Edinburgh Dental Hospital and School are fitted throughout with an electric lighting installation, also telephonic communication between stopping room and laboratory.

Grasmere.—The Local Board last week had before them maps from the Windermere Electric Lighting Company, showing the proposed route of the electric light cables. The matter is at present in abeyance.

Harrow.—On 6th inst., a public meeting was held which had been convened by the Local Board, and at which were present Messrs. R. E. B. Crompton and W. C. Hawtayne, electrical engineers, for the purpose of discussing the electric lighting question. The place of meeting was the Public Hall, which was electrically lighted both inside and out. It was stated that already enough private consumers had promised to take the light to pay the working expenses. The Local Board already have a provisional order, and at this meeting they presented a report regarding the proposed lighting. The result of the discussion was the passing of a resolution thanking the board for their report and requesting them to take no further steps towards the promotion of electric light in Harrow. Amendments asking the board to seriously consider the question were lost. According to a local paper the voting was hardly a fair index to the feeling of ratepayers, as a great many voted who were not electors.

Leeds.—The Corporation are negotiating with the Yorkshire House-to-House Electric Supply Company for the supply of electricity to light the Town Hall and Municipal Buildings.

Leith.—The extensive drapery premises of Messrs. Wm. Jeffrey & Son, have been lighted by electricity, both arc and incandescent lamps being in use. The total candle-power of the lamps will be 20,000; the arc lamps are 1,250 candle-power.

London.—The Commercial Union Assurance Company have decided to light their new buildings in Cornhill throughout by means of electricity. The installation will contain probably about 600 lights. Messrs. H. W. Handcock and A. H. Dykes have been appointed consulting engineers, and Messrs. Hayward, Tyler, & Co., have instructions to proceed with the work at once.

The premises of the Royal Geographical Society in Saville Row have lately been re-decorated, and the electric light has been introduced throughout.

Newcastle.—The Electric Lighting Committee of the Newcastle Corporation are still considering the question of further illuminating the city by means of electricity, and of seeing whether it is not possible to take the lighting arrangements into their own hands. To this end each of the electric lighting companies in the city have been approached, but nothing definite has been done. Professor Kennedy, who visited Newcastle some time ago to note for himself the suitability of so supplying the city, will, it is understood, make a report on the subject to the Corporation in January.

Sheffield.—According to the *Sheffield Independent*, there was a failure of the electric light about eight o'clock on Saturday night. "The occurrence created considerable inconvenience, and some business places in which there was no gas had to be closed, the people making shift with candles to see to shut up their shops. At the new Post Office, where there are only a few gas jets for sealing purposes, the sorting had to be done by candle light. The light was absent for something like an hour, and then the normal conditions were resumed."

Southampton.—The Town Council has decided not to oppose the application of the Southampton Electric Light and Power Company for a provisional order.

Southport.—While the Council were engaged discussing the increase in the gas lighting which had occurred since the electric light had been installed, the electric light suddenly failed, the chamber being thrown into darkness. Councillors were proceeding to another room to continue business, when the light was restored, so they returned to their original meeting place; two minutes later again it failed, but shortly after was set right permanently. The electricity minutes stated that the works were equal to a supply of 4,200 lights, but as 6,000 lights were being wired, the committee proposed to extend the works immediately, meanwhile appointing Mr. Arthur Ellis engineer at a salary of £208.

Sunderland.—A member of the County Council endeavoured to have passed a resolution rescinding the motion empowering a committee to spend £450 for electrically lighting the Town Hall, but he was not successful.

Swansea.—The Swansea County Council have recently consulted Mr. Manville, of London, regarding the lighting of the town by electricity. He estimates the cost at about £47,000. The question of site has not yet been gone into. According to the *Western Mail*, the council decided last week to place the work in Mr. Manville's hands at a remuneration of 5 per cent. on the estimated outlay.

Yarmouth.—The Council after having compared the estimates for lighting St. Peter's Road by gas and electricity, have decided to continue the present gas lighting. The cost of electric lighting was estimated at £48 per annum, and that of gas lighting £33 15s.

A. J. Harris & Co.—This firm, of Sedgwick Street Electric Works, Bradford, are supplying dynamos of various sizes, to the trade only, from 900 watts for 15 lamps, to 24,000 watts for 400 lamps. We have received a copy of their price list.

Catalogues, &c.—The Sperry Electric Company, of Cleveland, Ohio, have placed before us a pamphlet which is being circulated by them, and which describes the railway lines and plant of the Sperry Electric Railway Company, of Cleveland. Some general remarks are made regarding electricity in its application as a motive power to street railways; other sections are devoted to different subjects connected with the use of the company's manufactures, *i.e.*, driving mechanism, controller, the Sperry electric brakes; some particulars regarding the manner of operating the brake are also given. The pamphlet, which is of very good paper, is illustrated by a number of photographs showing the kinds of cars in use on various lines; other illustrations show a truck fitted with standard equipment and electric brake; motor showing brush holders, universal coupling, controllers, different parts of brakes, &c., &c.

From Messrs. King, Mendham & Co., we have received an illustrated price list of their electric and magnetic experimental apparatus, Wimshurst machines, electroscopes, electrometers, condensers, dischargers, Leyden jars, magnets, and magnetic apparatus, galvanometers, thermopiles, and a great variety of general apparatus of use to electrical students, experimenters, and others, are described and illustrated. The catalogue, on the whole is a very good one, and has been nicely compiled.

A very handy book for office use is the "Indian Engineer's Diary and Reference Book for 1895," a copy of which we have received from Mr. Ernest Benedict, the English editor of the *Indian Engineer*. In the opening pages is an A B C directory of British merchants and manufacturers, who, we presume, are already busy in the Indian markets, or are desirous of opening up business there for their manufactures. Information is included regarding the Government of India, and a large amount of the matter usually found in diaries regarding measurements, postal arrangements, &c., &c. A special paragraph takes for its subject India as a field for industrial enterprise, and gives some useful notes regarding the imports and exports of that great continent. One advantage this book has over many others of a like kind is the large space reserved for making memoranda each day during the year. The diaries are on sale at the offices of the *Indian Engineer*, 1, Victoria Mansions, S.W., and the price is one shilling.

Change of Firm.—We are asked to state that the firm of Richard L. Baxter & Co., mica merchants, will henceforth be carried on under the title of Baxters & Macdonald. The office address will be 81, Murraygate, Dundee, as formerly, and Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C., has been appointed London agent.

Edman v. Churton.—At the Nisi Prius Court at Leeds, before Mr. Justice Charles last week, this case was heard. The plaintiffs were the Rev. Ed. Hudson Edman, rector of Thornton-le-Moor, Caistor, Lincolnshire, and his son, C. E. Harold Edman, and the defendant was Mr. Churton, electrical engineer, of Leeds, and damages were sought for an alleged breach of the terms of a deed of apprenticeship, by the failure of the defendant to properly instruct the younger plaintiff in his business. A counterclaim was made by the defendant for the loss of the services of the younger plaintiff. Mr. Scott Fox appeared for the plaintiff, and Mr. Bairstow for the defendant. It was stated on behalf of the plaintiffs, that in 1891 the younger plaintiff, who was a minor, was apprenticed to Mr. Churton, to learn the business of an electrical engineer. In 1893 he went home ill, and it was alleged that this was due to overwork, and that he had not yet fully recovered his health. He stated that during his residence with Mr. Churton he had learned next to nothing. He admitted, in cross-examination by Mr. Bairstow, that no dispute or dissatisfaction arose, except in his "secret mind," at the extent of his instruction, until a dispute arose between his parents and Mr. Churton as to the amount due for his board. His father was very hard up, and was not able to pay the amount agreed upon. In the course of the dispute a letter was written to Mr. Churton by Mrs. Edman, wife of the senior plaintiff, saying that her son was very comfortable at Mr. Churton's, but that she could not afford to pay the terms for board previously arranged. After hearing the evidence, his Lordship gave judgment for the defendant, remarking that the case was one

which ought not to have been brought. Mr. Bairstow, addressing the Judge at the opening of the Court after the adjournment, said that having regard to his Lordship's views, the defendant was disposed to relinquish his claim for costs. His Lordship said that in that case the defendant had behaved very handsomely; it was an act for which he deserved the greatest credit.

Electrical Effects on the Stage.—Mr. J. T. Niblett, of the Lithanode and General Electric Company, Limited, writes, stating that the company's former attempts in introducing novel electrical effects on the stage have been the means of bringing them a very preat deal of work this year, not only in London, but also in the provinces. They have undertaken a quantity of novel work at the Lyceum, Olympia, Crystal Palace, and several other places of public entertainment in London, and in the provinces they have work in hand for Edinburgh, Manchester, Birmingham, Sheffield, and Portsmouth. This is an indication of how electricity is rapidly lending itself to the production of artistic and other pleasing effects.

"Electric Light Supplied from Municipal Works."—With this title Mr. Robert Hammond has brought out a small two-penny pamphlet, divided into four parts, dealing with (1) advantages of the electric light, (2) how obtainable, (3) cost of supply, and (4) general. A prefatory note says that the object of the pamphlet is to afford to intending consumers full information of the terms and conditions upon which they can obtain a supply.

"Electric Traction."—With this title an excellent publication has been brought out by the Electric Construction Company, Limited. The book contains a number of full page illustrations of some of the lines which they have equipped by the company, including photographic views of the Liverpool Overhead Railway, South Staffordshire Tramways, and Birmingham Tramways. First-class glazed paper has been used, and the blocks consequently print up very well. The book is a splendid piece of printing work, and has also been well compiled; it comes at an opportune moment, the question of light railways and tramways being well before the public at present.

Elmore's American and Canadian Patent Copper Depositing Company.—"A Shareholder" has written, as follows, to the *Financial News*:—"Having regard to the impossibility of obtaining satisfactory or definite information with regard to the progress of this company, I venture to . . . . bring to the recollection of other shareholders a company which, were it not for the losses it seems likely to entail upon numerous persons, might very easily be forgotten. In the prospectus dated January 26th, 1892, was intimated the intention of the company to erect in New York 'plant of a sufficient size to demonstrate, on a working scale, the merits and simplicity of the invention, the extraordinary low cost of manufacture, and the enormous advantage to users of the articles when so made.' In a later paragraph the directors expressed their great satisfaction in announcing that Messrs. Jere, Abbott & Co., had accepted the commercial agency for the United States. In a circular letter dated October 31st, 1892, issued 'by order of the board,' it was stated that after careful consideration and conference with Messrs. Jere, Abbott & Co., the board decided that the interests of the proprietors would be best served by postponing the erection of a trial plant in America, the reason being that the board was convinced that the mere erection of such plant, and the demonstration of the process on a comparatively small scale, would be insufficient to effect a re-sale of our property. As what seems to be the principal object of the company is, according to the statement of the board, insufficient, it occurs to me, as it has no doubt to other shareholders, that this should have been ascertained before the prospectus was issued and subscriptions for shares obtained. When the company had offices in London (I am not sure whether they now have) I was unable to obtain any information as to what, if anything, was being done by the company. I wrote, on more than one occasion, besides calling at the office. When I called I was only informed that some other board meeting was in progress, and, in effect, that I could not have any information. No doubt many, like myself, desire to ascertain what chance, however remote, there may be of obtaining some return for our money; and as the directors do not seem to be exhibiting any undue haste in giving effect to their anxiety to meet us in general meeting, you may, by kindly inserting this in your columns, bring the matter before somebody competent and willing to afford some reliable information. It would be a source of gratification to know who, if anyone, besides the vendors and promoters, is likely to obtain any pecuniary benefit from a company the avowed objects of which have been so ingeniously conceived and so brilliantly carried out."

Halifax and Bermudas Cable Company.—The Halifax (Nova Scotia) Exhibition Commission has conveyed to the superintendent of the Halifax and Bermudas Cable Company, Limited, its thanks for the very interesting and instructive exhibit of electrical instruments in use at a cable hut and office made by the company at the Provincial Exhibition. "The commission believes that never before has the actual working of an ocean telegraphic cable been shown at an exhibition on this continent, and adds that the silver medal awarded to the company is the highest award in the gift of the commission."

Immisch Electric Launch Company, Limited, v. White.—Before Judge Holl, at the Windsor County Court last Friday, an action was brought by the Immisch Electric Launch Company, Limited, against Mr. F. W. White, of Windsor, to recover £21 9s. 6d. as compensation for damages caused to the *Viscountess Bury* launch, through the alleged negligent navigation of the defendant's vessel. The plaintiffs stated that while the *Viscountess Bury* was being pushed away from the Windsor landing place, upon the occasion of the races, the *Amo* came astern before she had time to get away, and a collision occurred. For the defence, it was contended that the *Amo* was waiting for the *Viscountess Bury* to go out, that she was not being pulled astern, and that the collision was really caused by the *Viscountess Bury* getting too much across stream while attempting to go through the centre arch of Windsor Bridge. The Judge decided in favour of the plaintiffs, and allowed the amount claimed.

Night-Light Watch Stands.—Messrs. Siemens Bros. and Co., Limited, have sent us a list of their night-light watch stands, which consist of their dry cells used for intermittent lighting of low candle-power glow lamps, fitted in ornamental cases.

Partnership.—Mr. John A. Edmondson, of Globe Electrical Works, Bradford, announces that he has entered into partnership with Mr. Wilson Hartnell, M.I.M.E., of Volt Works, Leeds, and these two gentlemen will now carry on business under the style of Wilson Hartnell & Edmondson, as manufacturers of dynamos, motors, steam engines, &c., also as general, civil, consulting, and electrical engineers and contractors. Although the works and offices will be at Kirkstall Road, Leeds, the firm intend keeping up their Bradford connection.

Proposed Airdrie-Coatbridge Tramways.—The Town Council of Airdrie has appointed a committee to act along with a similar committee for the burgh of Coatbridge to consider the formation of a joint trust for the purpose of laying down a line of tramways from Drumpellier, in the west of Coatbridge, to Clarkston, in the east of Airdrie. The length of the proposed line would be about 4½ miles. One of the questions they will discuss is whether it shall be a cable or electricity line.

Ship Lighting.—A new steamer, *Inchanga*, erected by Messrs. Hall, Russell & Co., at Footdee, is fitted throughout with a complete installation of the electric light and electric bells by Messrs. Claude Hamilton, Limited, of Glasgow. The vessel is for Messrs. J. T. Rennie & Son.

Messrs. Harland & Wolff, last week, launched from their works at Queen's Island, Belfast, the large twin-screw steamer *Scotsman*, built to run in the Warren line between Liverpool and Boston. She is fitted with a complete installation of the electric light.

South Staffordshire Tramways Company, Limited.—A petition for compulsory winding up had been presented by five trade creditors, and on the matter being mentioned to Mr. Justice Vaughan Williams on Wednesday, it appeared that four of the petitioners had been paid, and the directors offered personally to pay the fifth, the amount being only £12. Mr. Levett, Q.C., for the Electric Construction Corporation, applied to be substituted for the petitioners, and pressed for an order to wind up. He had a claim for £30,000, although that, no doubt, was disputed. The only point against the claim appeared to be that Jabez Balfour was connected with the formation of the Electric Construction Corporation. Mr. Justice Williams: I do not know whether counsel wish me to hear the evidence with regard to the connection of Mr. Jabez Balfour with these companies. Jabez Balfour seems to have been connected with both companies. All I can say is that, having seen a good deal of his schemes, I think a great many of them were exceedingly good schemes. After a long argument it was agreed that the original petition should be dismissed, on the satisfaction of the debts of the petitioners; that the Electric Construction Corporation should immediately commence an action to establish its claim, the Tramways Company undertaking, pending the hearing of that action, not to interfere with the fund in Court.

According to the local press these tramways are at the moment at a standstill. "For some time past the relationship between the Tramway Company and the Electric Construction Company, which owns and works the cars, has been of a very strained nature. The directors of the Tramway Company having refused to pay the Electric Company on the terms of the contract, the latter company has given notice, and acted on it, that they should discontinue to supply power to run the cars, with the result that to-day we are without the ready means of locomotion which has become so requisite to our business requirements. Nothing in the system itself is at fault, for a more perfect system of tramway haulage has never been devised; that this is so is proved by the fact that the mileage run during the year has been 300,000 miles, as compared with 150,000 miles the last year the steam cars ran over the system. The fact speaks for itself. Pending an arrangement between the two companies, there is an effort being made to induce the Corporation to grant a temporary license for the use of steam cars."

"Shaydolite."—Messrs. Griffiths Bros. & Co. are introducing to the trade an article known as "Shaydolite," which they intend to supply as a cheap and easy method of toning down the light from incandescent lamps; and also, for decorative purposes, of obtaining variations of colour. Messrs. Griffiths also think it probable that there may be a use for "Shaydolite" in colouring the lamp glasses of the "Welsbach" lamp, as to many people the white glare of these lights is very trying. The article is supplied in most colours, shades of which can be obtained by mixing the colours one with another.

Telegraphs in Turkey.—A Commission has recently been appointed by the Turkish Department of Posts and Telegraphs to enquire into, and report upon, a project for a uniform tariff for telegrams in the Turkish empire.

The Exchange Telegraph Company, Limited, v. Gregory & Co.—Before Mr. Baron Pollock and Mr. Justice Grantham last Saturday there was an application for leave to give notice for a motion this week for an injunction to prevent a stockbroker

from using the wires of the telegraph company as to prices of stock, &c. The company, with the assent of the Postmaster-General, and under a contract with the committee of the Stock Exchange, have the sole right of publishing what are called the "tape" prices of stocks, showing the constant fluctuations in the prices on the Stock Exchange, for which privilege the company pay heavy royalties to the committee, and one of the terms of their contract is that the company shall not give any of these prices to "outside brokers," *i.e.*, brokers not members of the Stock Exchange. The Stock Exchange Committee had therefore compelled the company to withdraw its telegraph instruments from several of these outside brokers, and among others from a firm of brokers known as "Gregory & Co.," who, however, had by some means, as had been recently discovered, been enabled to put up several instruments in their office or shop, by which the trade prices are ascertained and printed, and put on a blackboard in their office, where, it was said, they are read by their clients. This had only been discovered quite recently, and it was desired to put a stop to it, and on an affidavit setting forth these facts, Mr. Shortt applied for leave to give notice to move before this Court on Thursday (yesterday) for an injunction to prevent the defendants from using the telegrams of the company as to the prices of stock. The Court gave the leave asked for. When the case came on for hearing yesterday the judges dismissed the application.

The Railway up Snowdon.—The cutting of the first sod of the railway, from Llanberis to the summit of Snowdon, took place on Saturday last. Sir Douglas Fox is the engineer, and the contractors are Messrs. Holme & King, of Liverpool and London. The *Times* says that steam will be the motive power at first, but eventually, if a steady supply of water-power can be obtained, electricity will be adopted.

The Unbreakable Pulley and Mill Gearing Company, Limited.—This company have supplied one of their "Gorton" patent gas engines for the new warehouses of Messrs. Harrington & Fox in St. Paul's Street, Leeds.

Wiring and Lamp Table.—The General Electric Company, Limited, have just brought out a wiring and lamp table called "The Omega." Particulars are given of the carrying capacity at 1,000, 750, and 500 ampères per square inch in ampères, and 4-watt 100-volt lamps, of various sizes of conductors. The sizes of suitable casings, and the loss of current for stated lengths, are also given. The table is in the form of a folded pocket-card, which makes it very convenient for carrying about. It should be very handy to wiremen and others interested in the fitting up of installations.

Warwick Castle.—The electric lighting installation was completed some days ago, and current has been switched on. The castle has been lighted throughout, and the drive from the lodge at the main entrance has also been provided with electric lamp. Altogether about 500 lamps of different C.Ps. have been installed, and in the state rooms, great hall, and other parts of the castle great care has been taken to instal the wires without in any way disfiguring the old panellings and tapestries. In the great hall the handsome wrought-iron gasolier, hanging from the centre, has been converted to hold little clusters of 5-C.P. lamps, in place of the old gas burners, as also have the iron standards around the wall. The power required for generating the current will be supplied, when there is sufficient water in the river, by a turbine, which has been fixed in the wheel-pit of the old mill below the castle, and as a provision in times of drought, or as an auxiliary power, a gas engine has been provided, which, together with the dynamos, storage batteries, and all necessary plant for a complete installation, have been put down in a machinery house specially erected inside the ruins of the old mill. The work has been carried out under the supervision of Mr. Vaughan Fowler, M.I.E.E., consulting engineer, the contractors being Messrs. Edmondsons, Limited, of Westminster, Messrs. Gilbert Gilkes & Co. having supplied the turbine.

CONTRACTS OPEN AND CLOSED.

OPEN.

Scarborough.—The Lamps Committee has been instructed to obtain tenders for the lighting of certain streets in the borough by electricity. This is for the Castle Hill scheme.

Spain.—January 3rd. The municipal authorities of the little town of Hellin, in the province of Murcia have recently decided to light the public streets by electricity, and are inviting tenders until January 3rd for the establishment of a central station and the carrying out of the work, under a 30 years' concession.

Walsall.—December 24th. Tenders are invited for alterations to buildings at the Wolverhampton Street Gas Works, including the construction of boiler house, dynamo house, offices and other works connected with the electricity generating station. Further particulars to be obtained from the Borough Surveyor, Bridge Street, Walsall.

Great Yarmouth.—January 2nd. Tenders are invited for installing the electric light at the Town Hall, free library, and Great Yarmouth police station, for the Town Council. Particulars can be obtained at the office of Mr. J. W. Cockrill, A.R.I.B.A., A.M.I.C.E., borough surveyor, Municipal Buildings, Great Yarmouth.

CLOSED.

Aberdeen.—The tender of Messrs. J. H. Holmes & Co. for supplying engine, dynamo, and other plant for the extension of the electric lighting system, for the Town Council has been accepted.

Blackburn.—The Council has accepted the tender of Messrs. S. Z. de Ferranti, Limited, for the supply of electric meters.

Cambridge.—The Town Council have received tenders from two local firms for the necessary electric wiring of the Guildhall Street wing of the new municipal buildings. That of Messrs. Bailey, Grundy & Barrett, Limited, at £68 8s., has been accepted.

NOTES.

The Western and Brazilian Telegraph Company, Limited.—This company last Friday received the following telegram from their representative at Rio de Janeiro:—"Fourteenth Purchase passed third reading in Senate yesterday, and sent to President for sanction."

Electric Street Lighting at Munich.—The Municipal Assembly, at the application of the magistracy, has recently resolved upon the extension of the electric street lighting, and has granted for this purpose a sum of 2,000,000 marks. The existing installation includes 210 arc lamps of 10 ampères and 56 5-ampères, and, as it is well known, actuated by two turbine stations belonging to the city, utilising the water-power of the Isar. The installation has hitherto worked in an excellent manner, and the universal favour which street lighting with arc lamps has enjoyed in Munich, has induced the magistracy to a considerable extension of the system, so that in future not only the main streets and squares of the inner city, but also the side streets and the suburbs, will be illuminated with the electric arc light. There will be installed, in addition, 456 arc lamps at 10 ampéres, and 48 at 5 ampères. As motive power the current of the Isar will be utilised, for which purpose new works will be erected at the Maximilian wier, the efficiency of which will amount to about 400 H.P. By way of reserve, a steam installation is provided which will be situate in the Muffat Works turbine station. The execution of the electric portion of the undertaking is again entrusted to the Electric Joint Stock Company, formerly Schuckert & Co., of Nürnberg. After the completion of the extension, Munich will possess by far the largest system of electric street lighting of the Continent, and will be the first city in Europe which has extended the use of the arc light to all streets within its jurisdiction, and has rendered it no longer a mere luxury, but an installation for real utility.

Electric Haulage in a Michigan Mine.—The use of the electric locomotive in mine haulage work becomes daily more widespread as the advantages inseparable from the adoption of electricity in mines become better recognised. In coal and iron mines they are steadily supplanting the rope systems and mule haulage, and the time seems rapidly approaching when mines having a large output will generally adopt electric power for this purpose. About two years ago the Pittsburgh and Lake Angeline Iron Mining Company determined to instal an electric plant, after having become convinced of the economy of the step. At the surface a power house was constructed, and a 14 × 30 Reynolds-Corliss engine erected to drive a D-62 500-volt General Electric bi-polar generator. Armoured mains are taken down in the mine on porcelain insulators, and connected in the usual manner to the trolley wire and track. The haulage plant proper consists of two General Electric T.M.M. 15, 30-inch gauge locomotives, each being equipped with two motors. The locomotives are capable of exerting a draw bar pull of 1,500 lbs. each, at a speed of from six to eight miles an hour. The motors are of the iron-clad waterproof type. The length of the haul is somewhat short for locomotives, but is too long for profitable tramming by men, the distance averaging from 250 to 1,400 feet. The grade is 8 inches in 100 feet, in favour of the loaded cars, and the curves are sharp, varying from 12 feet radius up, on account of the narrow veins. No serious delay has occurred since the plant began operation. The cost of hauling at the present rate of working, which is not up to the capacity of the locomotives, is 2s. per ton, including oil, waste and repairs.

Personal.—We regret exceedingly that the Clinical Lecture on "The Removal of Nævi by Electrolysis," which we reprinted in our issue of the 7th inst. from the *Clinical Journal* (a marked copy of which was sent to us as we thought to deal with), was inserted in the Electrical Review without the knowledge and without the permission of the writer of the article, or of the editor and proprietors of the *Clinical Journal*.

The Scott Electric Flashing Lamp.—We cull the following from the *Western Morning News*, of 13th inst.:—"After a trial extending over two years, the Scott electric flashing lamp has been pronounced by the Admiralty as unsuitable for the naval service. This lamp, an invention of Col. (?) Scott, was introduced into the navy with a view to testing its efficiency as a masthead signalling lamp. It was supplied to the battleships *Ramillies*, *Royal Sovereign*, *Rodney*, *Sans Pareil*, and *Trafalgar*, the cruisers *Æolus* and *Spartan*, and the signal schools at the home ports. It was desired that the lamp should give distinct intermittent flashes by means of metallic jalousies. It has been found, however, that the delicate mechanism necessary to work the jalousies, although giving the desired results during a short trial, becomes disabled when the light has been burning any length of time on account of the expansion due to heat. The reports sent to Whitehall from the ships mentioned differ only in detail, and, after careful consideration, the Admiralty have directed that the Scott lamps now in use are to be returned to the makers, and they will be replaced by the multiple fibre electric flashing lamp."

"A Promised Surprise to the Electric World."—There have been a good many surprises in the electrical world, but the *Clydebank and Renfrew Press* promises a grand one at an early date, and one which we understand "will bring the name of Clydebank into greater prominence, if it does not stamp it as the birthplace of an entirely new form of electric power." Still, quoting from the picturesque language of our contemporary, we are told that this generator is warranted to produce electricity at an incredibly small price. . . . . By the use of this generator . . . . . electric lighting will be a thing of very little cost . . . . . and that with this as a motive power even Atlantic liners can be made to cross the "pond" at the rate of 40 to 60 knots an hour, or more, for a mere fraction of the present outlay." Whether our contemporary is prompted by caution to say *an hour or more*, or whether it means 60 knots or more an hour, we cannot say. We must really make another extract from the inspired article:—"This generator will occupy very little space, will be easy to keep up, and will not readily get out of order, so that the huge boilers and engines at present in use in propelling our merchant vessels will be a thing of the past. We are also promised that by this self-same generator the almost insuperable difficulty in cost of lighting our towns with the electric light will be removed. This discovery has been patented all over the world by a number of very influential local gentlemen, who, after having seen it in use, have formed themselves into a company to work the patent and bring it under the notice of the public and the scientific world. A number of experts are said to have inspected the 'generator,' and to have expressed a very favourable opinion of it." Obviously enough, they have accomplished at Clydebank what we have long waited for. The world has yearned a long yearn for the generator which will produce electricity at a small price, and it has sighed many sighs of different size for a motive power which will propel Atlantic liners at 40 knots an hour. And to think that Clydebank should be the seat of the revolution of electricity. Well, great things come out of small places! This generator which is going to shake the electrical world is a primary battery. It generally is. The primary battery is the philosopher's stone of modern times. It has had more energy put into it than is ever likely to be obtained from it. Yet to warn people of the folly of plunging into primary batteries seems to be mere waste of time. Some day, may be, an investigator, imbued with all the energy and the hopes of the ancient alchemist, with a fortune at his back, may achieve a little, but bearing in mind what has gone before, the thousands upon thousands of pounds that have been wasted, the lives that have been used up, is it to be marvelled at that we look upon all primary batteries for large purpose as snares and delusions?

Lectures.—At the fortnightly meeting of the University College Engineering Society, held last week in the lecture theatre of the Walker Engineering Laboratories, Mr. B. H. Collins, A.I.E.E., secretary of the Liverpool Electric Supply Company, Limited, read a paper entitled "Central Station Lighting in Liverpool," with special reference to the Oldham Place station. The paper included descriptions of the boilers, engines and dynamos, switchboard and connections, accumulators, transformers and mains, and was illustrated by diagrams and lantern views.

On 12th inst. Dr. J. A. Fleming lectured in the Public Hall, Redditch, on "Magnets and Electric Currents."

At Montrose, last week, Mr. Peter Maney read a paper before the Artisan Literary Society on "Municipal Electric Lighting."

On 14th inst., before the Photographic Association of Glasgow, Mr. Adamson delivered a lecture on his patent incandescent system of electric light photography.

Liverpool Electric Lighting.—The Corporation recently appointed a committee to consider the question of the proposed purchase of the electric lighting company's business and undertaking, and this committee has, so we are informed, come to an important decision. They recommend that the Corporation offer to purchase from the Liverpool Electric Supply Company, Limited, the whole of the undertaking and business of the company as a going concern during the year 1895 (instead of waiting until the period arrives when the Corporation can compel the company to sell their undertaking as a going concern) at such price and on such other terms and conditions as may be agreed upon between the company and the Special Lighting Committee, or, failing such agreement, as may be settled by arbitration in the manner provided by the Liverpool Electric Lighting Order, 1892. The special committee have also recommended the Corporation to authorise the Special Lighting Committee to take such steps as they may think necessary to ascertain the cost of, and to formulate the details of, the scheme for supplying all the public buildings and markets in the city with electric light from a generating station or stations to be established by the Corporation. In the event of these recommendations being adopted by the Corporation, it will be a lesson to other authorities threatened by companies seeking electric lighting powers, to keep the work in their own hands, by laying down installations at once. The Liverpool Electric Lighting Committee have evidently had their eyes opened to the prosperous future in store for the electric lighting business in Liverpool. It will be interesting to hear what terms are arranged between the parties.

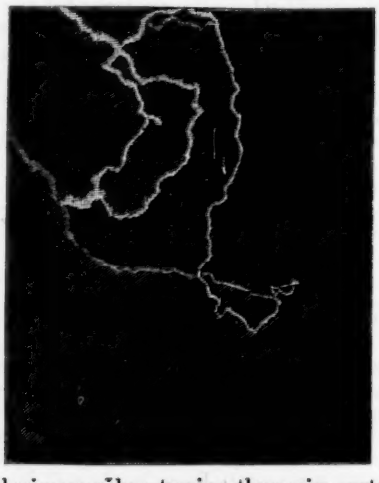
The Pacific Cable.—A representative of Reuter's Agency recently called upon Lord Jersey, and also upon a number of the Colonial Agents-General, with the object of learning what was likely to be the practical outcome of the Ottawa Conference. Lord Jersey stated that before anything could be done it was necessary to learn the views of Her Majesty's Government. Sir Robert Herbert, Agent-General for Tasmania, said that at present he was not in favour of the Pacific cable scheme, and that he did not think his colony would be willing to incur a share of the heavy cost of the cable. Mr. Duncan Gillies, Agent-General for Victoria, said that he was sure it would be found necessary to have a duplicate Pacific cable, and that unless the Imperial Government came forward handsomely, nothing could be done. The Hon. Thomas Playford, Agent-General for South Australia, said that, in his private opinion, he doubted very much if the financial position of the Colonies would induce them to pay the subsidies asked, either for cable or steamship communication, at the present time. He added, regarding the Pacific cable, that if the Imperial Government say it is required for the purposes of the defence of the Empire, and is willing to bear its share of the cost, he believed that the Colonies would be prepared, when their financial position warrants it, to assist in it being laid down; but that they would expect the Eastern Extension Telegraph Company and the South Australian Government who helped to construct the present cable, and laid the land line across Australia, would be guaranteed against any loss in consequence of the construction of a rival line. Sir Westby Perceval, Agent-General for New Zealand, said that his colony was most anxious for the connection with Canada by sea and by cable.

Manchester Electric Lighting Works.—A meeting of the Manchester Association of Students was held on Wednesday evening, last week, when Mr. C. H. Wordingham, A.M.Inst.C.E., read a paper describing the Manchester electric lighting works.

The Queen's Visit to the Riviera.—According to last Monday's daily papers the difficulty which arose in regard to the renting of the Grand Hotel de Cimiez for the accommodation of Queen Victoria on her visit to the Riviera next spring, was connected with the building of an electric tramway on the Boulevard Cimiez, passing the eastern entrance of the hotel. M. Dosse, Her Majesty's Director of Continental Journeys, has now obtained a promise from the Prefect that the work shall be completed by the end of January, and that the tramway service shall be suspended during the Queen's promenades in the grounds.

Royal Institution of Great Britain.—The following are the arrangements for Friday evening meetings before Easter, 1895:—Friday, January 18th, Prof. Dewar, M.A., LL.D., F.R.S., M.R.I., "Phosphorescence and Photographic Action at the Temperature of Boiling Liquid Air." February 22nd, Prof. A. Schuster, Ph.D., F.R.S., F.R.A.S., "Atmospheric Electricity." March 8th, Prof. A. W. Rücker, M.A., F.R.S., M.R.I., "The Physical Work of von Helmholtz." March 15th, Prof. Roberts-Austen, C.B., F.R.S., M.R.I., "The Rarer Metals and their Alloys."

Lightning Strikes a Lighting Circuit.—Writing to the New York *Electrical Review*, Joseph Flesheim, Menominee, Mich., says: "I enclose herewith a photograph taken during a thunderstorm by Richard Rea, a young man of this city. The picture was taken about 9 o'clock p.m. The bolt struck



the neutral wire on a low tension three-wire system. The only damage was the blowing out of the safety plugs in about one dozen dwellings in the immediate vicinity of where the bolt struck. Perhaps this picture may be of interest to your readers, and you have permission to publish it."

Balls for Packing Purposes on Rod Ends.—The C. W. Hurst Company, of New York, appear to be taking up the system of rod adjustment by means of balls as a regular feature in their engines. In this system the rod ends are made with a cavity adjoining the brasses. This cavity is filled with hardened steel balls of various sizes, and the space they occupy can be made smaller by screwing into it a set screw, the point of which displaces the balls as though they were liquid, and this brings pressure upon the brasses. It is essential that the balls be of different sizes; if alike, they would lock like a solid, but cannot if different. They vary from $\frac{1}{8}$ to $\frac{1}{4}$ inch diameter. After the set screw has been screwed in to its head, a few more balls are placed in the cavity, and this can be repeated till the brasses are worn out. We should think there must be a future for this system. Great care is needed in setting up such a bearing, for the action is practically that of a liquid, and very little force must be put upon the set screw, or the pressure on the nick would be many tons, as it would be if the cavity were filled with a true liquid.

Niagara.—We understand that Prof. George Forbes, F.R.S., who has been engaged for the last three years on the work connected with the utilisation of Niagara Falls, left New York on Saturday last for England by the *Campania*, the construction stage of the work being now completed.

Interruption of Telegraphs with Australia.—On Tuesday last, telegraphic communication through Australia was totally interrupted, excepting with Western Australia. Restoration has been made. We understand that the breaks occurred in the land lines only.

Resistance of the Human Body.—The *Electrical World* says "the much vexed question of the resistance of the human body has been solved, it is said, by a Frenchman, who states that its resistance when placed in a bath of water is slightly greater than that of the volume of water which it displaces." We fail to see what this has to do with the resistance of a human body out of water.

Wanted a Financier.—Perhaps some of our readers could help the correspondent who writes to us as follows:—"Providing a man has a really scientific idea for a new and improved means of doing something, and has only a small balance at his bankers and does not wish to risk that, what would be your advice? Are there people in London or elsewhere at the present time who would be willing to deal honestly and fairly with an inventor of respectability. For instance, would they undertake to finance him in his invention? Would they pay him a respectable income during the construction of a company, and plant for testing and experimenting and improving his invention, and would they give him besides his regular annual income, a dividend in proportion to the success of the idea? If so, kindly say if you will give me a personal interview this week, or after Xmas? as I believe I have the solution to an immense problem.—Obscure."

Serious Accident to a Wireman.—A carpenter, named John Jefferey, has just been awarded £150 damages in the Westminster County Court for injuries he received while in the employ of Messrs. Pritchett & Gold, electrical engineers. Jefferey was working on the roof of a lift cage fitting electrical wires in the well, when the foreman, who was working also on the cage roof, wanted to go into the basement. He let the cage down, and plaintiff was directed by him to hold the wire into a groove, so that the cage did not scrape the wire and injure the insulation. They went down all right, and then plaintiff was to go up on the cage roof alone, holding the wire to protect it as when coming down. All went well until he got to the second floor, when he alleged the lift suddenly went rapidly, and he fell half off the cage roof into a recess. The cage went on, and his body was half on and half off the cage. He was jammed, therefore, in a terrible way, his spine being broken, the use of his legs gone, and he was otherwise badly injured. The plaintiff, who, according to medical evidence is permanently crippled, has a wife and seven children to support.

The Indian Telegraphs.—The official report on the working of the telegraph systems of India in 1893-94 shows that, notwithstanding the heavy expenditure incurred in additions to lines, increase of accommodation, plant, and apparatus, the net return on capital to the State was 4·61 per cent. The outlay from the commencement of telegraphic operations in India aggregates the total of 566 lakhs of rupees, of which 22½ lakhs were spent during the past year. The additions made during the year were 1,677 miles of line and 8,004 miles of wire. The working expenses were Rs. 53,04,761, while the revenue receipts amounted to Rs. 80,07,306. At the close of the year the Indian Telegraph Department possessed 3,627 offices, 42,707 miles of line, 134,255 miles of wire, and 274 miles of cable. The principal source of revenue was derived from private messages, which show an increase of 194,480 on inland and 14,266 on foreign messages, giving a net increase of 5·11 per cent., or Rs. 4,03,668, in excess of last year, the highest figures yet attained. A marked increase is also noticeable in the revenue derived from inland deferred messages, the tariff for which was reduced in 1891-92.

Apparent Death from Electric Shock.—The form of the suggestions which we have issued for the treatment of persons who have accidentally received an electrical shock, will be seen from the illustration. The suggestions are printed on stout paper, are mounted with roller, and are

ready for hanging on the wall. We refer to them again because we are anxious that they should be in the hands of all electrical people. No charge is made for the sheets, and they will be sent post free to any address.

The Makers or Otherwise of Electric Traction.—Some weeks ago a contemporary admitted that it was possible to gain knowledge of a man in twelve months. It is very likely that the same remark may be justified in another twelve months. We are led to say this owing to a note anent Mr. Carruthers Wain and accumulators, which are to the effect that at the time we were sending to press our remarks of last week on the difficulty of obtaining accumulators, "Mr. Carruthers Wain, the president of the Tramways Institute—a man with no prejudice for any system, electrical or other, but ready to try anything that would pay—was speaking at the Institution of Electrical Engineers of the hopes he had respecting certain coming trials of the Theryc-Oblasser battery at Birmingham." Without saying anything against Mr. Wain, we should not be inclined to condemn a system because he abandoned it, nor should we be prone to accept, without ample evidence, any system that he recommended. With regard to Theryc-Oblasser batteries, we could, if we chose, perhaps give Mr. Wain a good deal of information which he apparently does not possess respecting this particular battery.

NEW COMPANIES REGISTERED.

R. Waygood & Company, Limited (42,679).—This company was registered on the 5th inst. with a capital of £60,000, in £10 shares, to acquire and take over as a going concern, and carry on the business of constructors of, and dealers in, lifting machinery, and of hydraulic, electrical, and general engineers and contractors, heretofore carried on at Robert's Place, Falmouth Road, Great Dover Street, S.E., and elsewhere, under the firm of R. Waygood & Co. The first seven subscribers are: H. C. Walker, 5, Robert's Place, S.E., engineer, two shares; C. Day, 5, Robert's Place, S.E., engineer, one share; J. B. Nicholson, 5, Robert's Place, S.E., engineer, one share; E. P. Okeden, 5, Robert's Place, S.E., engineer, one share; W. R. Green, Queen's Road, Peckham, engineer, one share; J. M. Day, 41, Nunhead Grove, S.E., engineer, one share; D. W. R. Green, Queen's Road, Peckham, clerk, one share. The first directors are H. C. Walker, C. Day, and E. P. Okeden; qualification, £1,500; remuneration to be determined in general meeting. Registered by Lee, Ockerby & Everington, 114, Queen Victoria Street, E.C.

Lowcock, Hill & Co., Limited (42,692).—This company was registered on the 6th inst. with a capital of £15,000, in £10 shares, to acquire and carry on the business and undertaking of electrical engineers carried on by G. W. Lowcock and G. Hill as Lowcock, Hill & Co., at 2, St. James Square and 20, South King Street, Manchester, and 349, Chester Road, Cornbrook, in the same city. The subscribers (with one share each) are:—G. W. Lowcock, 2, St. James Square, Manchester, electrical engineer; G. Hill, 2, St. James Square, Manchester, electrical engineer; J. C. Kendal, 2, Fairfield Villa, Chester Road, Manchester, electrician; R. R. Williamson, Higher Broughton, traveller; J. Hill, jun., 47, Egerton Road, Fallowfield, Manchester, electrician; W. R. Lees, Brookes Bar, Manchester, electrician; W. J. Fowler, Manchester, book-keeper. There are never to be more than seven directors; qualification, £100; remuneration to be fixed in general meeting. Registered by J. H. Boardman, 41, John Dalton Street, Manchester.

Thomas Winter & Co., Limited (42,700).—This company was registered on the 7th inst. with a capital of £15,000 in £100 shares, to acquire and carry on the business of Thomas Winter & Co., and to carry on the trades of machinists, mechanical engineers, and general hardware merchants, electrical engineers, and suppliers of electric light, heat, and motive power. The subscribers (with one share each) are:—R. Ryden, Clayton Lodge, Clayton le Dale, mill furnisher; Thomas Winter, 11, Princes Street, Blackburn, engineer; J. C. Calvert, Ashgrove, Waterford, cotton manufacturer; J. Winter, 11, Princes Street, Blackburn, book-keeper; H. Calvert, Ash Grove, Waterford, cotton manufacturer; J. W. Winter, 11, Princes Street, Blackburn, engineer; M. Ryden, Clayton le Dale, married woman. The first directors are T. Winter, R. Ryden, and J. Calvert. Qualification £100; remuneration to be fixed in general meeting. Registered by Jordan & Sons, 120, Chancery Lane, W.C. Registered office, Perseverance Works, Byron Street, Blackburn.

John Fielmann & Co., Limited (42,729).—This company was registered on the 10th inst. with a capital of £10,000, in £1 shares, to carry on business as lace and hosiery merchants, lace and hosiery manufacturers, and dealers, manufacturers, engineers, and suppliers of steam and electric power. The subscribers (with one share each) are:—J. Feilmann, 14, Rope Walk, Nottingham, merchant; M. Lowenstein, 12, Short Hill, Nottingham, merchant; J. Levi, 12, Short Hill, Nottingham, merchant; J. Sondheimer, 41, Green Street, New York, merchant; C. Rogers, Nottingham, chartered accountant; G. H. Walters, Nottingham, warehouseman; J. G. Widdowson, Nottingham, warehouseman. The first directors are J. Sondheimer and J. Levi. Qualfication £100; remuneration to be fixed in general meeting. Registered by Jordan & Sons, 120, Chancery Lane, W.C.

Rose & Bird, Limited (42,753).—This company was registered on the 11th inst., with a capital of £3,000, in £1 shares, to carry on the business of electricians, mechanical engineers, and manufacturers of and dealers in all apparatus, mechanical appliances, and other specialities (including all glass and mechanical work), and things required for, and being used in connection with the generation, distribution, supply, accumulation, and employment of electricity. The subscribers (with one share each) are:—T. A. Rose, Laurel Bank, Acton, W., electrical engineer; J. A. Bird, 120, Newgate Street, E.C., merchant; C. W. Scudamore, Acton, widow; T. M. Shadwell, Acton, W., retired mechanical engineer; J. B. Rose, Laurel Bank, Acton, W., widow; M. Shadwell, 4, Emanuel Avenue, Acton, W.; E. H. Jones, 5, John Street, W.C., solicitor. The first directors are T. A. Rose, J. A. Bird, and T. M. Shadwell; qualification, 200 shares; remuneration, £1 1s. each per monthly business meeting. Registered office, 120, Newgate Street, E.C.

Rogers Arc Lamp Company, Limited (42,767).—This company was registered on the 13th inst. with a capital of £20,000, in £5 shares, to adopt a certain agreement made between J. W. Rogers and A. Rogers, and to carry on the business of an electric light company in all its branches, of electricians, electrical and mechanical engineers, suppliers of electricity for the purpose of light, heat, and motive power, and to acquire the provisional specifications for improvements in arc lamps in the inventions of J. W. Rogers, Nos. 9,762, 10,634, 15,360, and 17,000. The subscribers (with one share each) are: J. W. Rogers, 7, Hargrave Park, N., engineer; A. Rogers, 7, Hargrave Park, N., gentleman; T. H.

Oswald, 33, St. George's Road, E., engineer; L. H. Guinness, Ipswich, brewer; A. Tillyer, 134, Osbaldeston Road, N., merchant; J. T. Lobb, 11, Queen Victoria Street, E.C., solicitor; P. J. Nicholls, 11, Queen Victoria Street, E.C., solicitor. Mr. J. W. Rogers is to be the first manager of the company, at a salary of £200 per annum. Table "A" mainly applies. Registered by H. F. Kite, 11, Queen Victoria Street, E.C.

Electric Battery Company, Limited (42,755).—This company was registered on the 11th inst. with a capital of £30,000, in £5 shares, to adopt a certain agreement dated December 7th, 1894, made between H. T. Barnett and F. J. Moffett, with reference to the sale and purchase by this company of certain patents for improvements in primary batteries and motors, and to carry on in any part of the world the business of manufacturing, working, using, letting on hire, and selling electric batteries, machinery boats or vessels, implements and things for the production, transmission, storage and use of electric, magnetic or other forces. The subscribers (with one share each) are:—A. Gripper, 40, Seething Lane, E.C., insurance broker; H. N. Godward, St. Margaret's Mansions, S.W., secretary; T. H. Dacres, 39, Victoria Street, S.W., engineer; F. J. Moffett, 42, St. Julien's Road, N.W., electrician; W. R. Bourke, 39, Victoria Street, S.W., accountant; W. J. Catley, 162, Farringdon Road, E.C., shipping agent; J. Fford, 17, Victoria Street, S.W., civil engineer. The first director is Mr. S. B. Saunders. Qualification 100 shares; Table A mainly applies. Mr. Saunders's remuneration is to be £400 per annum. Registered by Bates & Co., 30, Bedford Row, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Swinburne & Co., Limited (38,214).—This company's last return shows that out of a nominal capital of £25,000 in 300 deferred and 4,700 ordinary £5 shares, 1,686 ordinary, and the whole of the deferred shares, have been taken up. The full amount has been called on each of 100 deferred, £4 on each of 1,026 ordinary, and £1 10s. on each of 660 ordinary shares. The sum of £5,594 has been received, and £2,650 has been agreed to be considered as paid.

Blockley Electric Lighting and Manufacturing Company, Limited (25,527).—This company's yearly return shows that out of a nominal capital of £20,000, in £5 shares, 461 ordinary and 72 preference shares have been taken up. The full amount (£2,665) has been called and paid in all cases.

West Hampstead Foundry and Engineering Company, Limited (38,815).—This company has notified the Registrar of Joint Stock Companies that its registered office is now at Bridge House, 181, Queen Victoria Street, E.C.

Richard Poore & Co., Limited (39,024).—This company's latest return shows that out of a nominal capital of £6,000, in £1 shares, 4,830 shares have been taken up, of which 3,500 have been issued as fully paid. The full amount has been called on the remaining 1,330 shares; £1,242 10s. has been received; and £87 10s. is outstanding.

Chloride Electrical Storage Syndicate, Limited (35,389).—The annual return of this company, filed on September 24th, 1894, shows that out of a nominal capital of £262,500, in 110,000 "A," 140,000 "B," and 12,500 founders' shares, all of £1 each, 70,000 "A," 100,000 "B," and all the founders' shares have been taken up. The full amount (£25,000) has been called and paid on 25,000 "A" shares, and £157,500 has been agreed to be considered as paid on 45,000 "A," 100,000 "B," and the whole of the founders' shares.

Economic Electric Specialty Company, Limited (41,561).—This company's statutory return, filed on November 16th, 1894, shows that out of a nominal capital of £50,000, in £1 shares, the whole of the capital has been taken up. The full amount has been called on seven shares; £4 has been received in response to calls; £3 is outstanding; and £49,993 has been agreed to be considered as paid.

CITY NOTES.

British Aluminium Company, Limited.

This company, the nominal capital of which is £300,000, has this week been inviting applications for an issue of 15,000 7 per cent. cumulative preference shares of £10 each. The directors are A. S. Bolton, J.P. (of Thos. Bolton & Sons); A. A. Common, LL.D., F.R.S.; Harvey Du Cros; Robert Heath, J.P.; E. Ristori, A.M.I.C.E.; W. L. Thornton; and R. W. Wallace. The scientific adviser is Lord Kelvin, and the secretary Charles F. Jones, of 9, Victoria Street, Westminster, S.W. The company was formed for the purpose of making aluminium in this country by the electrical process now carried on by the Société Anonyme pour l'Industrie de l'Aluminium de Neuhausen, in Switzerland, and by the Société Electro-Métallurgique Français, at Froges. The company intends acquiring mines in the North of Ireland, which will furnish the raw material, also certain patents and water power, as well as the freehold land and factory of the Cowles Syndicate Company, at Nulton, near Stoke-on-Trent. Lord Kelvin's report speaks very favourably of the patents. The list closed on Wednesday.

The Electric Battery Company, Limited.

The prospectus has been issued of the above company, which has been formed with a capital of £30,000 in £5 shares. The company is formed to acquire and work valuable patents relating to the manufacture of electrodes, electric batteries, and motors, and to acquire the property and business of the Battery and Motor Company at Petersham Island, Richmond, Surrey. The Velvo-carbon battery belongs to the company. The probable business of the company has been estimated to amount by sales to £20,000 per annum, which is calculated to leave a dividend of 10 per cent. upon the nominal capital of the company. Mr. H. T. Barnett, M.I.E.E., is the general manager, and the board of directors includes Mr. W. J. Dawson, J.P., of Westoe and Quayside, Newcastle, and Mr. Wasteneys Smith, C.E., M.I.M.E., Newcastle; the managing director is Mr. Stephen B. Saunders, of 53, Victoria Street, Westminster.

We understand that when the list closed on Wednesday the capital was insufficiently subscribed, and the company consequently will not go to allotment.

Elmore's German Company.

The third annual meeting of the company was held at Winchester House on Wednesday. After dealing with the various items in the report, the Chairman (Mr. John MacFarlan) spoke most hopefully of the future work of the company. They had secured many satisfactory contracts, and it was the belief of the board that the works would soon be too small to cope with the demand for the goods. In reply to questions, the Chairman said that the loss of £7,700 made by the German Company was made up of establishment expenses and depreciation, which by the German law it was necessary to write off at once. The amount now due from customers was £2,500, while the company owed about £2,000. After a long discussion, the report was adopted.

New Telephone Company, Limited.

At a special meeting of this company, held on Wednesday, at the Cannon Street Hotel, a resolution for formally winding up the undertaking was passed.

Mr. J. S. Forbes, the chairman, remarked that the company had served its purpose, as it was thought that the telephone business of the country could be best carried on by one company instead of two. By winding up the company they would get a return of the large amount of capital which had been for so long tied up.

Eastern Telegraph Company, Limited.—The directors announce the payment on January 14th of interest of 3s. per share, less income tax, being at the rate of 6 per cent. per annum on the preference shares for the quarter ending December 31st, and the usual interim dividend of 2s. 6d. per share on the ordinary shares, tax free, for the quarter ended September 30th.

The Metropolitan Electric Supply Company, Limited.—This company announces the payment by warrants on January 1st next of interest from July 19th last (or from the respective dates of payment of instalments) to December 31st on the 4½ per cent. first mortgage debenture stock. The transfer books will be closed from December 18th to December 31st, both days inclusive.

The West Coast of America Telegraph Company, Limited.—The coupons due 31st inst. on the debentures of this company will be paid by Messrs. Barclay & Co., Lombard Street. Coupons should be left three clear days for examination.

The City of London Electric Lighting Company, Limited.—Warrants for the interest payable January 1st, 1895, at the rate of 5 per cent. per annum for the six months ending 31st inst. on this company's first issue of £100,000 debenture stock will be posted on December 31st, 1894.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 16th, 1894, amounted to £962; week ending December 17th, 1893, £909; increase, £53; total receipts for half-year, 1894, £21,479; corresponding period, 1893, £20,097; increase, £1,382.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending December 16th, 1894, amounted to £917; corresponding week last year, £634.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 14th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,937.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation December 12th.	Closing Quotation, December 19th.	Business done during week ended December 19th, 1894. Highest.	Lowest
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	102 —105	...	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	38 — 39	38 — 39	...	...
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 5s.	£5 10s.	£5 2s.	71½ — 72½	71½ — 72½	72¼	71½
2,993,560*l*	Do. do. Defd.	Stock	...	...	...	6¼ — 6⅝	6½ — 6⅝	...	...
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½ % §	6½ % §	11 — 11½	10¾ — 11¼	11¼	10⅞
75,000*l*	Do. do. 5 %, repayable June 1906	100	...	...	...	114 —115	111 —115	114½	114
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10% ‖ §	... §	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	140 —150	140 —150	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½ % §	2 % §	2 % §	1/16 — 1/8	1/16 — 1/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13¼	12½ — 13½	13½	13⅜
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½ %	4 %	4 %	4¼ — 4⅜	4¼ — 4⅜	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9½ — 9⅞	9½ — 9⅞	...	...
30,000*l*	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	105 —108%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½ % §	3½ % §	2⅝ % §	8½ — 9	8¼ — 8¼	8⅝	8⅜
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½ % §	6½ % §	6½ % §	15⅞ — 16¼	15⅞ — 16⅛	16⅛	15⅞
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16¾ — 17¼	16⅝ — 17¼	17	16⅞
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	103 —110	...	...
1,297,837*l*	Do. 4 % Mort. Deb.	Stock	...	...	...	119 —122	119 —122	120⅜	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	16 — 16¼	16 — 16¼	16¼	16
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —107	103 —107	...	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	104 —107	104 —107	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	118 —122	118 —122	...	...
95,100*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —107	103 —107	...	...
129,100*l*	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	104 —107	104 —107	...	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	105 —108	105 —108	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	107 —110%	108 —111%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	5⅛ % §	4⅞ % §	4⅝ % §	8⅝ — 8⅞	8¾ — 9	9	8¾
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15¾ — 16¼	15¾ — 16¼	16⅛	15⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜ % §	8⅜ % §	8⅜ % §	21¾ — 22⅛	21¾ — 22¼	...	...
190,000*l*	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	106	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	47 — 49	47 — 49	48½	...
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000*l*	Do. do. 6 % Debs.	100	...	...	...	102 —106	102 —106	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼ — ⅜	¼ — ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1⅛ — 2⅛	1⅛ — 2⅛	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	5⅛ — 5⅜	5⅛ — 5⅜	5 1/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 17	15 — 17	16 1/16	16¼
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	15 — 16	15 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5¾ — 6	5¾ — 6	5 1/16	5⅞
1,000,000*l*	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	110 —113	110 —113	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	7/16 — 9/16	7/16 — 9/16	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	105 —108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	3 — 5	2 — 4	3⅛	...
3,381	Submarine Cables Trust	Cert.	...	...	...	107 —111	109 —114	111	109½
58,000	United River Plate Teleph., Ltd.	5	...	...	...	1 — 2	1 — 2	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	...	...	...	88 — 94	88 — 94	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
238,300*l*	Do. do. do. 5 % Debs.	100	...	...	...	101 —104	101 —104	103⅝	103½
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½ — 2½	1½ — 2½	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	100 —105	100 —105	...	...
64,245	Western and Brazilian Teleg., Ltd.	15	4 %	2½ %	2½ %	11½ — 12	11½ — 12	11⅞	11⅝
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6½ — 7	6¼ — 6⅝	6½	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	5 — 5½	5 — 5½	5⅝	5 1/16
171,900*l*	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	101 —105	101 —105	...	...
214,800*l*	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	101 —105	101 —105	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼ %	¼ %	⅜ %	1 — 1¼	1 — 1¼	...	...
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	10¾ — 11¼	10¾ — 11¼	11⅛	10⅝
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	..	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	109 —112	111	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	112 —118	112 —118	...	...
166,900*l*	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½ %	4½ — 5⅛	4½ — 5⅛	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	13½ — 14½	14 — 15	14⅝	14
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	14¾ — 15¼	14¾ — 15¼	15 1/16	...
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	132 —135	132 —135	...	...
50,000	†Liverpool Electric Supply, all paid	5	4½ %	5 %	5 %	7⅜ — 7½	7⅜ — 7½	7½	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	1 %	2 %	2½ %	9¾ — 10¼	9¾ — 10¼	10⅜	9⅞
100,000*l*	Do. 5% Deb., bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	...	...
150,000*l*	Do. 4½% first mortgage debenture stock	...	...	...	...	115 —117	115 —117	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	7 — 7⅛	7 — 7⅛	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½ %	7¼ %	4½ %	7⅜ — 8¼	7⅜ — 8¼	8	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9	8½ — 9	...	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½ %	4 %	7¼ — 7⅜	7 — 7⅛	7 5/16	7 3/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital

Dividends marked § are for a year consisting of the latter part of one year and the first part of the

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Dec. 12th.	Closing Quotation, Dec. 19th.	Business done during week ended Dec. 19th, 1894. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000	3	...	6 % §	6 % §	2⅜ — 2⅝	2⅜ — 2⅝	2⅝	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 % §	6 % §	2¼ — 2½	2⅜ — 2⅝	2 9/16	2⅜
125,000£	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000£	City and South London Railway	Stock	...	⅝%	⅝%	41 — 43	42 — 44	42⅝	42¼
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	7 % §	2⅜ — 3¼	2⅜ — 3¼	...	...
50,000£	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	96 —101	97 —102	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	½ — ⅝	½ — ⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½ — 2	1½ — 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	*nil*	¼ — ½	1/16 — 3/16	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1½ — 1⅝	1 — 1¼	1 5/16	⅝
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	⅞ — 1⅛	¾ — 1	1	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½ — 1½	½ — 1½	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½ — 7½	6½ — 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8½ — 9½	8½ — 9½	9¼	9½
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	25½ — 26½	25½ — 26½	26¼	25 13/16
200,000£	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8½ — 8⅝	8⅝ — 8¾	...	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13¼	13 — 13¼	...	...
	Swan United Electric Light, Ltd.	...	11 % §	10 % §	7½% §	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	42¾	42½
150,000£	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	106 —109	106 —109	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2¼ — 2½	2¼ — 2½	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6.
Electric Construction Corporation, 6 % Debentures, 93—97.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 2⅛—2¼.
Do. do. 7 % Preference, of £5, 6½—6⅝.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4⅜—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6½—6⅝.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4½—4⅝.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

THE EARLY MORNING TEST IN TELEPHONE OFFICES.*

By JAMES W. MANSON.

In every telephone office a test of all wires entering the exchange is made in the morning by the day operators, a piece of work which, when carefully done, well repays the trouble taken, but which should not be, as is often the case, the only regular means of obtaining information about the electrical condition of subscribers' lines. Without underestimating the value of a morning test by the operators, and, in fact, regarding it as indispensable, it may yet be said that the circumstances under which it is made are not the most favourable that could be desired.

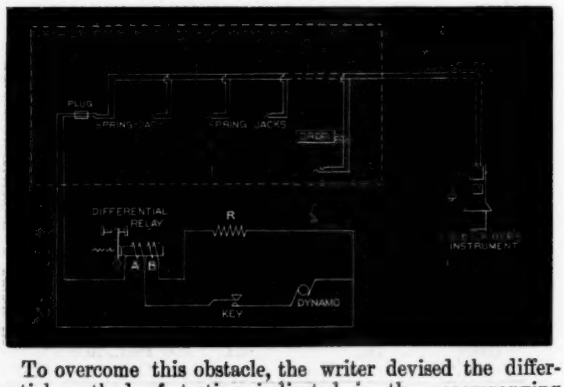
The work is, of necessity, divided among the whole force on duty, with the result that every operator applies to the circuits in her allotted portion her own standard of what constitutes a properly working line, and does it, too, under very trying conditions. Again, the work is not, strictly speaking, "operating," and, while it lasts, it delays regular business to some extent; two considerations which make it looked upon by some as a perfunctory task to be got rid of as soon as possible.

Leaving aside these shortcomings, however, the serious objection remains that the test is not finished before the greater part of the subscribers are in their offices—a comparatively late hour in the morning—and, as a consequence, a large proportion of the lines found in trouble by this means is not repaired till late in the forenoon, at a time when the need for telephones has much diminished.

This is a bad start for a day's work, and the office manager has the unpleasant knowledge that his linemen have lost an hour or more, waiting for orders to go on troubles that developed over night, but of whose existence he was ignorant.

In the company with which the writer is connected, it is the practice to have all lines tested by the night manager for "ground" and "open," by means of a relay and battery. It is possible, in this way, for one man to quickly try every working wire in the early morning, and prepare a list of troubles to be acted on as soon as the day force arrives. Experience has abundantly shown the value of this system.

With the older styles of switchboard, in which the insertion of a plug cuts out the drop, it is an easy matter to test all wires from one of the sections of the board itself; but, with the bridging type of board, the case is more difficult, as the drop is never cut out, and a line will show closed through the drop irrespective of its condition outside the office.



To overcome this obstacle, the writer devised the differential method of testing indicated in the accompanying diagram. In the latter, the part within the dotted lines represents the course of a circuit through the switchboard,

* New York *Electrical Engineer*.

with normally open springjacks and high resistance drop. On the right is the line leading to the subscriber's station; the lower part of the figure shows the testing outfit, its essential features being a differentially wound relay or galvanometer; a resistance, R, equal to that of a regular switchboard drop; a dynamo or battery: and a plug with flexible cord to connect with any circuit desired.

To make the test, the plug is inserted in a springjack, as shown, and the key closed. In case the line is open at any point outside the office, the current from the dynamo divides equally between the two coils, A and B, of the differential relay, with consequently no effect on its armature. If, on the contrary, the line is intact, coil A gets more current than coil B, as the joint resistance of subscriber's line and drop in parallel is less than that of R. When a line is closed, then the relay armature is attracted with an intensity proportional to the difference between the currents flowing through the coils A and B.

With a long line and high resistance instruments at subscriber's station—the most unfavourable conditions for the test—this difference is, of course, small, and the writer would recommend the use of a rather sensitive relay or galvanometer to obtain the best results.

As to the advantages of early morning testing, it is unnecessary to say more, for, though often unappreciated, they cannot well be disputed, nor can the statement that an office failing in this respect, loses a valuable auxiliary in the detection of trouble.

BOARD OF TRADE INQUIRY REGARDING TRANSFORMER CHAMBERS.

AT No. 7, Whitehall Gardens, on Thursday, the 13th inst., Sir Courtenay Boyle sat to hear an appeal to the Board of Trade of the County of London and Brush Provincial Electric Lighting Company in reference to objections put forward by the London County Council and others to the construction of transformer pits under the streets. Major Cardew, Electrical Adviser to the Board of Trade, and Mr. F. G. S. Hopwood, C.W.G., of the Railway Department, were with the Chairman; the London County Council was represented by Mr. Bassett Hopkins, and the Wandsworth District Board of Works by Mr. Earls; Mr. C. A. Cripps, Q.C., appeared for the County of London Company, and Mr. Scott, on behalf of Mr. Germaine, for the House-to-House Electric Lighting Company.

The CHAIRMAN said he thought they settled at the last time of meeting the basis of the method of procedure, and he should like to know if anyone wishes to raise any objections to the course proposed.

Mr. CRIPPS raised the question as to the limits of the inquiry. He contended that under the provisional order Parliament had approved of the principle of placing transformers under the streets, which was an important matter of public policy, and what the Board of Trade was called upon to say was, whether the particular method of the company was consistent with public safety. It was beyond the jurisdiction of the Board of Trade to say whether or not transformers generally might be placed under the streets.

The CHAIRMAN said the question of going under the public streets for public purposes had been determined by Parliament, but he was not certain that it had been determined that the transformer chambers might be put under the streets.

Mr. BASSETT HOPKINS, on behalf of the London County Council, and Mr. EARLS, on behalf of the Wandsworth Board of Works, having argued that it was within the scope of the powers given to the Board of Trade to decide whether any transformers should be placed under the public roads,

The CHAIRMAN said he knew enough about the compilation of these orders to be quite certain that when application was made to Parliament for authority to put street boxes under the streets, there was no idea in the minds of the Board of Trade that street boxes would be extended to mean large transforming chambers, taking up an immense amount of space. He was quite convinced that the Board of Trade had jurisdiction to determine the issue before them, and he thought it would be convenient to take the objections first.

Mr. BASSETT HOPKINS, for the London County Council, said there were serious objections to the occupation of the subsoil for the purposes required, especially as there was no knowing to what extent these transformer chambers might eventually be required. On the last occasion objections were put forward as to the policy of allowing these chambers to be constructed, except where no alternative system could be suggested, and it was argued that it was merely a matter of relative convenience and relative expense. He gathered that consideration of the convenience of a private company would not be allowed to prevail over public convenience and the well-being of the community. It was not necessary that they should demonstrate that the transformer chambers would necessarily be a source of danger; it would be sufficient to justify, at any rate, a postponement of sanction to those chambers, if they reasonably showed that they might be a source of danger. Electric lighting was still in its early youth, and there had not been anything like experience of various systems of supply to justify them in coming to any final conclusion. Taking the facts into consideration, the London County Council felt bound to exercise some supervision, and to see that the powers which had been given were not abused.

Mr. BINNIE, chief engineer to the London County Council, examined by Mr. BASSETT HOPKINS, said he considered the proposed chambers were objectionable upon several grounds. They interfered with a certain amount of cross-sectional capacity of the streets in which they were placed; there was the possibility of explosions from the accumulation of gas in the chambers; the street water was likely to run into them, and there was the probability of obstruction to the street traffic by the raising of the lids when the company's servants made their inspections, which they would have frequently to do. He put in plans, and contended that it would be impossible to drain the transformer chambers. The proposed method of ventilation by means of grids would but add to the liability of the chambers being flooded by storm water. The main drainage system which the County Council were carrying out, and which necessitated continual development, would be seriously interfered with by the multiplication of these chambers. It was possible that explosions might be caused by the dropping of lighted matches through the grids. The subsoil of the metropolis was simply black with accumulations of gas.

In reply to Mr. CRIPPS, WITNESS said he objected generally to the placing of transformer chambers under the streets, and not merely to this particular system. He did not think it was possible for the company to properly ventilate vertical pits of the kind they proposed with the powers they now had. If they ran a ventilating shaft up the side of a house from the pits, or if they used some mechanical means to pump air into the chambers, that would probably be efficacious, but they had not the necessary powers to enable them to do that. The alternative plan which he suggested was that the company should hire cellars adjacent to the streets, and place their transformers there; it would then be a much more simple matter to secure proper ventilation and protection in other ways.

Dr. JOHN HOPKINSON said he did not think chambers beneath the street were the best means of dealing with a transformer system. In Manchester, cellars contiguous to the streets were hired for the purpose. The great difficulty would be to secure adequate ventilation, and he did not think the means suggested by the company would achieve the desired end. In Manchester the lighting was done by the Corporation; they worked at a tension of 400 volts, and they employed the continuous current five-wire system. The transformers there were of a different class from those used by the County of London Company; they were small machines, and were used to equalise the pressure between one section and another. Very frequent inspection would be necessary in the case of underground transformer chambers, and the covers would have to be taken up for an appreciable period in every day. It might cost more, but there was no other objection that he knew of to placing the transformers upon private ground; or they might be dispensed with altogether, and some other system adopted. It was simply a question of convenience and cost. It would be cheaper to put the transformers under the streets, but he did not think the consumers would benefit in consequence, and he did not see why they should.

Replying to Mr. CRIPPS, Dr. HOPKINSON said there were only two transformer stations at Manchester. He had seen the plans for the proposed chambers in London, and he certainly thought gas would get into those chambers. It was true a grid was provided, but it did not follow that the gas would rise and pass out through that grid.

In answer to Sir COURTENAY BOYLE, WITNESS said his chief objections to the chambers proposed was upon the grounds of ventilation and size; the larger the chamber the greater the danger if an explosion occurred.

By Major CARDEW: At Manchester the transformers were moving machines, and there was almost a certainty of small sparks at the brushes with such transformers.

Mr. JAMES ENRIGHT, of St. Mary's College, said he had conducted a great many experiments touching the subject, and was of opinion that accumulations of gas would be sure to occur in the proposed underground chambers. Although the walls might be airtight to begin with, heavy traffic along the street might cause them to crack. Hydrogen might get in, even though there were no cracks; but road subsidence was the chief source of danger of causing accumulations of gas. If water got into the chambers, there was a possibility of electrolysis being set up, and hydrogen thereby generated. Insulated wire, if heated, would give off gas; he had made experiments which showed that by heating an insulating material to a moderate temperature, a combustible gas was given off; he had found this with India-rubber and with other insulators; even paper would give off an explosive gas under certain conditions. He did not consider the transformer chambers necessary under the streets for the proper and efficient, working of an electric lighting system; on the contrary, he believed they would be much more convenient for the company's servants if they were placed elsewhere. He had personally inspected a transformer chamber opposite the Finchley Road Railway Station. That chamber was 6 feet long by 7½ feet deep. The cover was perforated, but there were no other means of ventilation, and the holes would allow water to run through into the chamber. He did not consider it safe to take high tension leads into such transformer chambers. The current might be taken up by a streak of water on the walls, and a person walking overhead might, under certain conditions, receive a shock.

Mr. GUNYON, assistant engineer to the London County Council, and superintendent of electric work, agreed with the former witnesses in regard to the inadvisability of putting the transformers under the public thoroughfares, either from an engineering or a drainage point of view. He did not think it could be reasonably expected to keep the chambers watertight. In a chamber in Rosebery Avenue there was a persistent leakage, though a slight one, notwithstanding the substantial character of the construction.

Sir Benjamin Baker said there was greater difficulty every year in occupying the subsoil with new things. In each session of Parliament opposition increased, and there was greater reluctance to cede any existing rights in regard to the occupation of the subsoil. For this reason all recent applicants for underground railways had been driven lower down, below the sewers and other pipes; whereas if these had been kept up to the level of the proposed transformer chambers, hundreds of thousands of pounds might have been saved which had now been expended in costly works. If Parliament would allow such interference as would be caused by these chambers, then the problem of light railways for London would be solved, because they could be made cheaply. If Parliament had contemplated such interference with the subsoil as was proposed in this case, he thought some reference would be found to it in the Act. The right to build the chambers was a large concession, and was worth a lot of money.

Mr. Earls, for the Wandsworth Local Board, said he would, to a large extent, adopt the evidence offered by the London County Council. His Board had no objection to the introduction of electric lighting; indeed, they were likely to become the largest customer in the district. But they did object to the placing of the transformers in chambers under the public streets, because of the possibilities of danger from gas explosions and other things.

Prof. Henry Robinson, scientific adviser to the Wandsworth Local Board, stated his objections to the particular form in which it was proposed to construct the chambers, but admitted that his experience had been in connection with low tension.

The inquiry was then adjourned for a week.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

The annual general meeting of the Institution was held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday evening, December 13th, Mr. Alexander Siemens, President, in the chair.

The Secretary read the annual report of the council, which showed that 14 foreign members, 13 members, 145 associates, and 123 students had been added to the register during the year, whilst 5 foreign members, 10 members, 18 associates, and 12 students had resigned; 24 associates had been transferred to the class of members, and 80 students to the class of associates. The Salomons Scholarship (value £50) had been awarded to Mr. Edward Ernest Hoadley, a student of the City and Guilds of London Technical College, Finsbury; the Institution Premium (value £10) to Mr. H. D. Wilkinson, for his paper on "Electric Tramways in the United States and Canada;" and the Students' Premium of £3 3s. to Mr. G. C. Allingham, for his paper on "Secondary Batteries." The subscribers to a fund for commemorating the memory of the late Mr. P. W. Willans, in connection with the branch of engineering in which he so greatly distinguished himself, had requested this Institution, and the Institution of Mechanical Engineers, to become joint trustees of the fund, the interest of which it was proposed to devote to the establishment of a premium to be called the "Willans Premium," and to be awarded alternately by the councils of the two Institutions every third year. The council had assented, on behalf of this institution, to the request of the subscribers, and the council of the Institution of Mechanical Engineers had done likewise. A committee has been appointed by each of the two councils, and those committees were jointly considering and settling all necessary details. The first award would be in December, 1897, and would be made by the Institution of Electrical Engineers. In accordance with the proposal put forth in the last annual report, the council had transferred the sum of £3,000 from the general investment fund to a building fund, and they had every reason to hope that they would find themselves able to increase that amount substantially each year. The council had again had the satisfaction of being invited by the Board of Trade to make suggestions in reference to important matters connected with the supply of electrical energy for the purposes of traction, and also in regard to light railways. The financial position of the Institution continued to be satisfactory, and there was every reason to expect that the accounts at the end of the year would show a considerable surplus. During the year the further sum of £204 16s. 6d. had been invested on account of life compositions, and £1,010 3s. 6d. on account of the general investment fund.

Upon the motion of the Chairman, seconded by Mr. Ferranti, the report was adopted.

The usual votes of thanks were passed to the Institution of Civil Engineers, for the use of the hall, to the local hon. secretaries and treasurers, to Sir David Salomons (hon. treasurer), the hon. auditors (Messrs. F. C. Danvers and A. Stroh), and the hon. solicitors (Messrs. Wilson, Bristows & Carpmael.

Sir David Salomons, in acknowledging the compliment paid him, said when he first joined the Institution, very soon after its origin, there were only about 200 members; now there were about 2,500. Their surplus instead of being, as he described it some years ago, £200, represented mainly by furniture, now consisted of over £1,000 in solid cash. They might well congratulate themselves when they remembered that this surplus was an increasing amount, and that they had now started a building fund, which he trusted they would make a permanent fund, to enable members to show their generosity by adding largely to it from their personal means. It was very desirable that they should eventually have a hall of their own, at least as good and as convenient as that in which they were then met, and he hoped to live to see the realisation of his hopes in that direction. He also urged upon them the desirability of supporting the provident fund, which had not, so far, been patronised as it ought to be.

The formal business of the meeting having been disposed of,

The President announced that the discussion on the various papers read upon Electric Tramways would be resumed.

Discussion on Electric Traction.

(*Continued from page* 700.)

Mr. F. F. Robinson said the excellent papers they had heard left an impression that elevated conductor work had arrived at a high state of perfection, and that but little room for improvement was left in regard to frogs, crossings, insulators and trolleys. When, however, rail-bonding was touched on, varied, and in most cases unsatisfactory, were the contrivances brought before them. He alluded to the lack of due proportion between contact surface with rail and sectional area of conductor. This deficiency having already been dwelt upon at some length early in the discussion, he would draw their attention to a new form of bond which he thought they would allow possessed considerable merit. Briefly, the conductor was made with large tabular terminals, which were roller-expanded into holes in the rail webs, and he might remind them that Mr. Yarrow (of torpedo boat fame) found by experiment that tubes so treated, if they were free, would become slightly larger, and the holes, if free, would become slightly smaller; in short, that the surfaces in contact were forcibly pressing each other. Tapered plugs might be used to attain a similar effect, but the cost of these in large sizes would be prohibitive, as unless carefully made they would be most unsatisfactory, bearing only a few points. No fear, he thought, need be entertained that heavy girder rails would be materially weakened by large holes cut near the neutral axis. He had only trespassed on their time because the rail bond seemed to have been in the past rather an unhealthy vital organ of the overhead system.

Mr. Frank Lea said he was glad to have an opportunity to make a few comments upon the subject of electric rack railways, and also to offer a few suggestions with regard to points arising upon the subject. Dr. Preller would confer a benefit upon them if he would give exact particulars with regard to the great saving he claimed for the use of electric rack lines as compared with those operated by steam. Of course, as electrical engineers, they were ready to admit and advocate the great economy of energy in any electric traction method; but at the outset it seemed a little unwise to try to prove too much. The difficulty hitherto had been in finding two really similar lines which might be at all adequately compared. In the second place he would be glad if Dr. Preller would give the cost of motor repairs on the Barmen line, which he had mentioned, and which was worked by electricity. One would feel inclined to think offhand that this item must be rather a heavy one, owing to the fact that the Barmen road was built on the plain step-ladder rack principle. The incessant jolting and jarring to the motors and gearing would, he thought, involve a great many loose connections, and also some amount of what the Americans called throwing solder at the commutator joints, especially when the motor got at all hot through excessive current, or long use. He did not refer, of course, to the jolting due to the unevenness of roadway, but to that due to the load partly coming on and going off as the engine pinion engaged and disengaged with the line rack. Some other systems of rack railway in that respect seemed better designed, for the engine pinion and rack teeth were "staggered" with respect to each other, and therefore maintained a continuous contact throughout the whole revolution. With regard to the general subject it would be of course quite evident to all those who had heard or read Dr. Preller's able and interesting paper that he had confined his attention entirely to what might be called isolated or independent lines, that is, to those lines which had no immediate or material connection with adjacent systems. They all seemed to have been designed and built for a purpose like that of the famous Duke of York, and without any ulterior motive; they simply marched up the hill only to march down again. It must be remembered that the field of the electric motor was a larger one than that. At the present moment, on the Continent and elsewhere, there was a large number of rack railways on main or continuous trunk lines traversing mountainous districts, and as regards some of those, Dr. Preller had given some excellent descriptions in the technical press. Those lines had, so far, been operated by steam locomotives of the combination type, each engine had a double set of cylinders, one set operating the adhesion wheel system in the usual way, the other coming into use additionally upon the rack sections for working the engine pinions. In rack sections of this type on a through route of tramway or railway a very great saving was effected both in capital charges and working expenses, and their advantages in this direction became even more pronounced when electric traction took the place of steam. It was quite possible, and not particularly difficult, to construct electric locomotives of the combination type suitable for adhesion and rack working, either or both, as the case might be. With regard to this line already mentioned, he felt sure that it would be of much increased value if it were connected at each end with adjacent tramway systems, so that the same rolling stock might be used on both the rack or adhesion lines. It was to be expected that the great extension which seemed likely to be made in this country of light railways or tramways would afford numerous instances where lines of this character would find an increasing amount of employment in the way he had sketched.

Mr. McGraw thanked the Institution for affording him the opportunity of speaking, but he really had not come to say anything at all, but had come there to listen. He was very glad to have had the opportunity of coming over to this side of the water to see what we were doing here in the way of electric and cable traction. They had done a great deal across the water, of some of which they felt proud, and some of which they called very important work; but they felt

very sure that England and the Continent would soon be abreast of what they had done over there, and, perhaps, would in many ways exceed it. Rapid transit in America was one of the most important industries there to-day, and they confidently looked forward to the time when it would be just as much or more so on this side of the water. He had not heard the papers read, and he did not feel able to discuss them; but he wished to invite them all to America to see what they had done, and he could assure them of a right royal welcome and every chance of inspecting the work of which they were so proud.

Major-General Webber said they felt much gratitude to the last speaker for the very kind and cordial offer which he made to the members of the Institution, and doubtless there were some present who would be ready in the next year or two to respond to that invitation. From their experience in the past, they felt sure that all he had told them, not only as to the welcome they would receive, but as to the interesting information they would acquire, would be fully borne out. It might be remembered that their President was delegated lately by the Institution to attend a meeting at the Board of Trade on the subject of light railways, and that he (the speaker) had the honour of being joined with him in that delegation. That meeting was so fully reported in the Press that nothing that could be said about it by those who were present would be a breach of confidence as to what passed. All who had been reading the papers, and the *Times* particularly, for the previous few weeks, must have felt that one of the objects of that meeting was to promote the extension of light railways, especially with the view of assisting the agricultural interests of this country, which those who had to do with it knew were in a very depressed state, and to enable that industry to compete with the great influx of produce, chiefly for domestic use, which was going on from the Continent. Those who were well acquainted with what was going on in Belgium, in Denmark, France, and Germany—(A Voice: "Spain also")—and Spain also, were aware that those railways which were being built were very largely supported by carrying from the centres of production, that was to say, from the small homesteads and the homes of the producers, this very produce which found its way to the market in London. Knowing that they could not help feeling that the consideration of those who were promoting light railways should be turned to enabling our agriculturists to have means of transport not merely from centres, but also almost from the very fields and from the homesteads. Now, in considering this subject, it had struck him that they, as electrical engineers, had a condition to think of which had not, perhaps, been brought so prominently before them as it might have been. If light railways such as suggested themselves to his mind, of narrow gauge, or rather of such a gauge that portable branches could be run into the fields as feeders, to be worked by hand, if these were to be used along roads and lines so as to be of real assistance to agriculturists, the traffic would probably be small. On some such lines along routes which they could all bring to their mind, there would not, perhaps, be more than two trains each way per day. He did not know how the electrical engineer was to provide a locomotive to draw those trains economically, unless the locomotive trolley was going to carry its own power. It seemed to him that it would never pay to put up a traction station, an electric generating station, for a line costing £2,000 a mile, or to maintain a generating station in use for storage, for the purpose of running two or three trains a day. But he could not help thinking that there they had a future for traction by storage, and it was a point which, he believed, if studied and carefully thought out and the experience they had already gained applied—he did not think it had been at all fully applied as yet in that direction—they would further this great object of being able to run trains for agricultural purposes through sparsely populated districts. If they were going to bring the produce of the country cheaply from the points of production to the markets, it had occurred to him that here was a favourable opening for the use of electric locomotives carrying storage batteries. He had nothing to suggest more than this, that the very small experience which they had had in this country should not leave them hopeless on this point, that traction by storage was a thing that might now be looked to for further developments, and that there was a useful and profitable field in that direction if their engineers would only turn their attention that way.

Dr. S. P. Thompson said he did not propose to add anything to the technicalities of the discussion that had been going on. He joined his thanks to those of others to the authors of the various papers for the very valuable information they had brought before the Institution, but he rose to speak very much more in the strain of his friend, General Webber. He was one of those who had had the advantage of seeing what had been done on the other side of the Atlantic. He remembered very well, going over last autumn, from his previous visit of nine years before, what an unpleasant effect was produced on the mind of the average Britisher by seeing all the arrangements of overhead wires and cables that at that time somewhat disgraced some of the American cities; and when he knew that he had to see something that had sprung up in those nine years—the trolley work, the overhead wires, the networks which had sprung up in connection with tramcars—he expected that his feelings of disgust of nine years ago at the fashion in which wires were strung overhead everywhere in a reckless way, and in every direction, would return with some intensity. But he must say that he came home with very different ideas, because our American cousins had mended their ways a great deal in regard to overhead lines. They did not have quite the unsightly arrangement of telephone wires of nine years before, the electric light wires were very much improved, and in many cases were laid underground; and, as one who objected very much to all these networks of wires, he came back with this strong impression: that of all the different kinds of overhead wires one might see, whether in America or in this country, the overhead construction which least disfigured the landscape, was least of an eyesore of all, was the construction of overhead wires for modern tramway work. Having made that statement, he would like to say that he thought not even our American cousins had entirely realised the importance of what they had done in constructing so many thousands of miles of light rails carrying electric tramcars from the centres of population and industry away into the surrounding districts. He meant, they had not realised the importance of this thing to themselves as a social factor. Anyone who visited, for example, Pittsburgh now, and who knew what Pittsburgh was ten years ago, would see that already the rapid transit from the centre of a thickly populated town to the outlying regions had had a distinct social effect. The workmen, instead of crowding into barracks and tenements in a densely populated street, to a very much larger extent lived in little villas each in its own little plot of ground, two or three miles from the centre, where life was more healthy and children much happier, thus returning to the more primitive civilisation of the village, instead of to the more desperate civilisation of the populous town, and this, thanks largely to the fact, that rapid transit was possible by means of electricity. Several other facts struck him in the social bearing of rapid electrical traction, and notably this, that a great part of the lines that were spreading out from town to town and from village to village across the State of New Jersey had been built—at whose expense? By money found, he was told, very largely from two sources, the insurance companies of New York and Philadelphia and the Pennsylvania Railroad. Now, those two facts were very striking. If there was one body that looked out for a sound sort of investment, he supposed it was an insurance company; and if there were any investments that were entitled to respect they were the investments of a railway company. Why should it pay any company like the Pennsylvania Railroad to promote tramcar transit by means of electricity? Simply because of this—and our own great railway companies in England would find it out—that it was a distinct gain to the management of a railroad to clear out the local traffic as much as possible, and allow the through traffic freer course. He believed we should find this an important factor here, that if we could have electric lines running out from our terminus stations a few miles into the country and feeding the terminus stations, it would greatly lighten the main traffic. There were many lines no doubt in this country, small branch lines off the main lines, which at present were worked at a great disadvantage often by the large companies, small lines built as a speculation, then taken over by a larger company, which at present did not pay by steam traction, but which would pay by electric traction, because where it would not pay to run two or three long trains it might pay very well to send one car an hour or every half hour by electric means. Here another social question came in. We wanted our civilisation to be improved and aided by these new means of traffic in the same way as steam traction had aided it as against the more primitive methods of travelling. This raised, however, another question, whether it was not advisable, having a well recognised gauge for our railways and well recognised style for our rolling stock, in all future schemes to consider a common gauge for electric tramways capable of running on the rails of the heavy railways of this country. That was, of course, a very large question, but it would be a great disaster if we did not consider it now in all its bearings. We did not want perpetuated in electric traction the same kind of miserable mistake as was made when the battle of the broad and narrow gauges was fought out on the existing railways. If we could prevent the great waste of money in having two gauges where one would have done the work, we should not have wasted time in discussing it, though some might say it was premature.

Mr. Carruthers Wain thought he would scarcely be able to add anything to the marvellous store of knowledge which had been already imparted to the members by preceding speakers and by the authors of the papers, to whom, in common with others, he felt he owed deep gratitude for the information they had given. But he had possibly some little excuse in speaking, and that was because, owing to circumstances, possibly, entirely beyond his control, he had probably had greater experience of electric traction in this country than—he hoped he said it with all due modesty—than any other man. The reason was exceedingly simple. It arose in consequence of his position as president of the Tramways Institute of this country, and also in consequence of his personal association with the companies on which electricity had been tried. General Webber and other speakers had referred to storage batteries. His experience with them had not been that overwhelming success which they had all hoped for, and no doubt the blame for that to some extent rested on a variety of shoulders. His own, he admitted at once, were not broad enough to carry all the blame, nor did he desire that unenviable distinction. It was due—and he said it frankly and unhesitatingly—the failure of storage batteries in England was due to a variety of causes, and not necessarily to the batteries themselves. For example, when they asked an accumulator car to grind its way through snow and ice over a line 1¼ inch wide to gauge, what could they expect but the exceedingly rapid deterioration of those batteries? And, furthermore, he would ask if batteries were allowed to wear out and were not replaced, and they charged them every journey, every six miles, what could they expect but that their working expenses would mount up to an alarming proportion, and, therefore, by the ignorant and prejudiced traction by storage batteries be regarded as a failure?

Major-General Webber asked if Mr. Wain was speaking of Birmingham?

Mr. Wain replied that he was, but he did not appear there as the advocate of any particular form of traction. His object, as the President of the Institute, was to find out the best form of traction. With that object he had experimented, he was going to say, with air, fire, and water. He had used steam by means of locomotives travelling on common roads; he had tried compressed air; he had tried, and was trying, oil; he had tried, and was trying, gas; he had tried accumulators of all types, the E.P.S., the Epstein, and the

Jarman, on different roads, and he had tried the overhead wire system. He hoped they would think he was entitled to the portion of the credit for that which ought to fall to his share for introducing into England the first complete system over an extended area of traction by means of overhead wires, that service which was in complete and successful operation to-day in the Black Country. In South Staffordshire they had a complete system equipped, he hoped and believed, on a method which would approve itself to those gentlemen who had preceded him, and which to his mind was not only satisfactory from the pecuniary point of view, but satisfactory even to those gentlemen who implored him almost with tears to do nothing in the way of overhead wires that would deface the picturesque beauty of the Black Country. He had endeavoured to keep his word. He did not think that the scenic advantages of the Black Country had suffered at his hands, and he was in hopes that by means of information such as had been supplied to them by these papers, by means of the diffusion of knowledge which that Institution was able to convey to the public, they would see a very large development of traction by means of overhead wires, because he could conceive nothing more economical, more speedy, and more pecuniarily advantageous to those who put their money into it. On that point he would like to say this:—He did not view it from the selfish point of view of one of the gentlemen who attended the congress last week at the Board of Trade, who, as the representative of the steel and iron industry, prayed for a wide extension of light railways, because there never was a time when the iron and steel industry needed assistance more. He was not interested in iron and steel, and his shares in electrical companies amounted to £4. But from the point of view of the traveller, of the tramway director, who wished to see absurd and obsolete restrictions removed—who wished to see railway and tramway legislation brought up to date in England as elsewhere, he did hope for the very best possible results from that conference. Their President and himself happened to be members of the committee which was appointed, and he hoped the president would make his still small voice heard at the right moment, and that the result would be satisfactory to him and to them. He apologised for not having conveyed any positive information to them except that he had done what he could, and that he should be only too glad to seize the opportunity to do more. At that moment he was doing something more. *Apropos* of accumulators, he had arranged for a demonstration of a battery of which they might have heard, which had been brought under his notice, and the merits of which he intended to test. He did not profess to know anything at all about it, because if he once called himself an electrical engineer, he should launch himself upon a sea of doubt and difficulty, and did not know where it would take him. He was going to try the Theryc-Oblasser batteries, which had been tried in Belgium and France, and a demonstration was to be arranged in Birmingham at an early date. Those who were interested in accumulator forms of traction would be glad to know the results of those trials, and if he might be permitted, he would have the greatest pleasure in communicating those results to the Institution.

(To be continued.)

NEW PATENTS—1894.

23,398. "Improvements connected with electric batteries." R. M. McDonald and A. McDonald. Dated December 3rd.

23,441. "Improvements in and connected with galvanic batteries." J. C. Fuller and G. Fuller. Dated December 3rd. (*Complete.*)

23,444. "Improvements in or relating to targets and electrical indicators therefor." A. Mantel-Rieter and E. Meyer. Dated December 3rd. (*Complete.*)

23,472. "Improvements in telephony and apparatus connected therewith. C. Adams-Randall. Dated December 3rd.

23,480. "A combined mat and electric alarum contact." J. J. Pye. Dated December 4th.

23,486. "Improvements in or relating to secondary batteries or accumulators." F. L. Berners and F. Griffin. Dated December 4th.

23,494. "Electric alternate current quasipolarised relays, indicators, and cut-outs." S. P. Thompson. Dated December 4th.

23,505. "Improvements in electric light fittings." J. McFarlane. Dated December 4th.

23,510. "Burglar-proof electric fastener and combination lock." A. Dalziel. Dated December 4th.

23,525. "Improvements in or applicable to electric switches." C. P. Ehmann. Dated December 4th.

23,529. "Improvements in connections for electric lighting and power." G. Lyon and H. Bevis. Dated December 4th.

23,553. "Improvements in apparatus for the electrical treatment of beer or other liquid or material." L. Wagner and J. Marr. Dated December 4th. (*Complete.*)

23,565. "Improvements in apparatus for transmitting and controlling work from an electromotor." A. Bergtheil and R. A. Marples. Dated December 4th.

23,590. "Improvements in gas batteries." H. T. Barnett. Dated December 5th.

23,628. "Improvements in or connected with means for transmitting signals made by flashes of light, and recording the transmission and receipt of signals made by flashes of light or other visual signs." J. B. A. Lege, J. C. E. Carre, and M. L. Isaacs. Dated December 5th. (*Complete.*)

23,656. "Improvements in or relating to electric heating and cooking appliances." F. W. Schindler. Dated December 5th.

23,661. "Improvements relating to electric telegraph automatic transmitting and receiving instruments." J. W. Willmot. Dated December 5th.

23,668. "Improvements in electric impedence or choking coils." W. J. Davy. Dated December 5th.

23,669. "Improvements in or connected with the electro-deposition of zinc upon iron." The Cowper-Coles Galvanising Syndicate, Limited, and S. O. Cowper-Coles. Dated December 5th.

23,679. "Process for the manufacture of metallic articles by electro-deposition." La Societe des Cuivres de France." Dated December 5th. [Date applied for under Patents &c. Act, 1883, Sec. 103, 22nd May, 1894, being date of application in France.]

23,680. "A process of and apparatus for making compressed electrolytic copper, applicable also to other metals capable of being deposited by electrolysis." A. M. Clark. (Communicated by La Société des Cuivres de France, France.) Dated December 5th.

23,685. "An improvement in brackets for telegraph poles." Siemens Bros. & Co., Ltd., and G. W. Perry. Dated December 5th.

23,688. "An improved charging material for galvanic elements." G. Platner. Dated December 5th. (*Complete.*)

23,697. "Improvements in the construction of electrodes." A. B. Woakes. Dated December 6th.

23,745. "Improvements in electricity meters." G. A. J. Telge. Dated December 6th. (*Complete.*)

23,748. "Improvements in or connected with dynamo-electric machinery." F. N. Mewton and T. Hawkins. Dated December 6th.

23,825. "Improvements in electric arc lamps." J. Brockie. Dated December 7th.

23,854. "Improvements in systems of electrical distribution." R. Wood. Dated December 7th.

23,858. "Improvements in the construction of instruments for measuring electric currents." F. H. Nalder, C. W. S. Crawley and A. Soames. Dated December 7th.

23,866. Automatic electrical fog signal." T. Thompson. Dated December 8th.

23,936. "Improvements in electrical fire and burglar alarms." J. R. Shearer. Dated December 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

19,427. "Improvements in electrical toys." R. Myers. Dated October 16th. Relates to a combined electromotor and battery which may be used as a toy or for light driving purposes, and also, if desired, as a shocking coil. 4 claims.

20,837. "Improvements in electrostatic and other electrical measuring instruments." W. E. Ayrton and T. Mather. Dated November 3rd. Relates first to safety arrangements for electrical instruments, which arrangements are particularly applicable to those intended for high pressure circuits where serious shocks might be received by persons touching parts electrically connected with the circuit; secondly, to devices for preventing damage by sparking across, or by internal short circuits in electrostatic instruments, some of which devices also serve for modifying the calibration curves and ranges of the instruments. 6 claims.

22,876. "Automatic electric switches." J. Hopkinson. Dated November 29th. Consists in making a contact piece in the form of a lever freely pivoted on a fulcrum carried by a shaft, which is forced up to its work by a spring or weight; this ensures that the pressure on the two contacts shall have a definite value, and be divided between them in a definite proportion. 6 claims.

23,211. "Improvements in electro-mechanical governors, and in the means of operating the same." W. T. Goolden and J. S. Lewis. Dated December 2nd. Relates more particularly to that class of governors in which a pair of oppositely situated wheels are brought alternately in gear with an intermediate wheel, one or the other of these being constantly in motion, producing a motion of the regulating mechanism in one direction or another. 3 claims.

23,605. "Improvements in the method of attaching reflectors to electric lamp-holders or sockets." P. G. Ebbutt and J. B. Verity. Dated December 8th. Claim:—The use of a tube, ring, or collar, screwed on the inside with a female screw to correspond with the male screw on the outside of an electric lamp-holder or socket in conjunction with a reflector or shade, or both.

24,001. "An automatic thermo-electric lubricating apparatus." J. Coombes. (A communication from abroad by R. N. Coombes, of Western Australia.) Dated December 13th. The inventor fits a tank or analogous article for containing the lubricant conveniently near to the bearing or other part to be lubricated. Near to the bearing he fits a thermometric tube and bulb, charged with mercury. Electric conductors are connected to the tube at certain points above the normal surface of the mercury. A pair of electro-magnets are also fitted, having suitable connections with a battery or batteries. An armature is fitted to or near the magnets, carried by one end of a scale beam, the other end of the scale beam carries a valve-rod and valve, arranged so that when the beam rises with the rod the valve is raised, and the lubricant is admitted to the bearing. An annular or other float is fitted in the oil vessel, carrying a pair of vertical rods, working in guides. 1 claim.